

# Marketing New England Poultry

## 3. Capital Accumulation Potential of Broiler Growers

BY

CLARK R. BURBEE AND GEORGE E. FRICK

AGRICULTURAL EXPERIMENT STATION  
UNIVERSITY OF NEW HAMPSHIRE  
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Farm Production Economics Division  
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## **PREFACE AND ACKNOWLEDGEMENTS**

This bulletin is the third in a series dealing with various aspects of the poultry industry in New England. In it, capital accumulation ability of broiler farms under various physical and economic conditions are analyzed.

The authors appreciate the cooperation of the several integrators and the many contract broiler growers that furnished the data necessary for this study. They wish to acknowledge the assistance of George B. Rogers of the Marketing Economics Division of the Economic Research Service, United States Department of Agriculture, during the conceptual and data collection phases of the study.

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# Marketing New England Poultry

## 3. Capital Accumulation Potential of Broiler Growers

By Clark R. Burbee and George E. Frick<sup>1</sup>

### Introduction

A very high proportion of commercial broilers and other meat birds are now produced under arrangements or contracts between the producers and other firms. Such arrangements involve cost sharing in the production of the birds and definite agreement as to production methods, market weight, and market outlet. Because this system of sharing financing and decision making generally includes some firm already providing a marketing or input service, such as broiler processing or feed manufacturing, it has been labeled "vertical integration". This term applies because the processor, for instance, through contracts with producers, shares control of firms in a second level of the production-marketing spectrum.

There are many reasons why vertical integration has developed so strongly in the broiler industry. The independent growers have been willing to transfer the risks inherent in the broiler market to the larger integrating firms in exchange for relatively steady incomes. The large processors require a high and steady volume of poultry to achieve low unit cost operations in their plants. The large feed millers seek to achieve low average cost production through assured high output of feed to their integrated producers. It is probably also true that large integrators obtain lower input prices through mass purchasing, and through standardized production management they can achieve a consistent quality broiler and a competitive advantage in the dressed broiler market.

All of the above reasons for the development of vertical integration would apply anywhere, but the development of specialized broiler producing areas in the Southeast, the Delmarva Peninsula, and Maine is the result of the availability of the necessary inputs and the potential higher returns to these inputs if they were put into broiler production. In New England, broiler production has increased particularly in Maine.

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<sup>1</sup> Clark R. Burbee is an Agricultural Economist, Marketing Economics Division, Economic Research Service, U. S. Department of Agriculture, and George E. Frick is an Agricultural Economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture.

Available resources existed in the form of submarginal dairy farms, surplus labor, an established hatchery industry, and the close proximity of the large metropolitan consuming areas of the Northeast.<sup>2</sup>

The recent and continuing developments in technology have created tremendous gains in labor productivity in the production of broilers. New types of equipment in the form of automatic feeders, waterers, heating equipment, and ventilation controls allow the family unit to produce flocks as large as 25,000 to 35,000 broilers. New developments in breeding and nutrition enable a grower to produce four to five flocks a year.

In an effort to reduce production costs and improve quality, integrators are looking to the producers for new housing with central heat and insulation, along with modern equipment, to replace the old converted dairy barns, laying houses and outmoded equipment. Furthermore, in an effort to reduce broiler assembly and feed distribution costs, integrators want to contract with full-time growers who can raise large flocks rather than with smaller part-time growers.

These developments in the industry focus attention on the problem of the potential of the contract grower to accumulate capital from his broiler producing operations. If the contract growers cannot accumulate capital to renovate or replace their existing plants, integrators will be forced to seek investment capital or to use their own to develop the required production facilities.

The study reported here was made to appraise some of the factors involved in the production phase of northern New England's broiler industry as they affect the capital accumulation potential of contract growers. The capital accumulation potential was measured using various prices and payment plans under several assumptions as to technologies and grower consumption expenditures.

The study involved long-run decision making; the results will be of little value in the day-to-day management of producing units. Moreover, since each existing farm is unique as to its labor, buildings, and location, this report cannot help either producers or integrators set a value on these features of existing farms. It does, however, show the value of and required payments to all resources that may be put into broiler production in the future.

## Procedure

This study was limited to the economic problems of the contract broiler grower in northern New England. Analysis of physical production input-output data provided the basic relationships for appraising economic returns of the producing unit.

First, physical input-output data from contract growers within integrated firms were analyzed to determine the trends in productivity of output and the restrictions on size of operation. Variables studied were feed conversion, rate of growth, and labor used in producing broilers.

Second, other factors that affect costs and returns of the production unit were studied, including the decision making power of growers and integrators, variations in output, fluctuations in prices, size and location of production units, and the types of contracts used in contract broiler

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<sup>2</sup> Saunders, R. F., *Contract Broiler Growing in Maine*, Maine Agricultural Experiment Station Bulletin 571, 1958, p. 7

production. Also an analysis was made of the various costs of the contract grower and how these costs vary with changes in income.

Third, estimates were made of probable incomes and expenditures for several model farms. This was done by applying the physical input-output relationships developed in the first step to conditions uncovered among the factors studied in the second step. The models were compared on the basis of change in net income. This was followed by a determination of capital accumulation potential of the various model grower units.

## Sources of Data For The Study

Data on feed conversion, mortality rate, flock size, age of broilers at time of sale, breed, and date of sale on a flock basis were collected from two integrators producing broilers primarily in Maine, New Hampshire, and Massachusetts. The larger firm furnished records for the 3-year period, 1956-1958 on 678 flocks consisting of approximately 6.6 million broilers. The second integrator furnished records for an 18-month period during 1957-1958 on 213 flocks consisting of 1.7 million broilers. In addition to these physical data, both firms furnished cost data.

Records of 14 other large integrators operating in northern New England were used to determine location of supply areas, decision making power concerning broiler production, and types of contracts used in contract broiler production.<sup>3</sup>

Farm records of a sample of 50 contract growers were collected in 1958 and from these estimates were made of labor utilization, construction and maintenance costs of broiler housing and equipment, and other fixed investment costs. These records were used to derive the contract grower's fixed costs, and also any size economies that may exist in broiler production with respect to labor. These farm records were collected in southern Maine, southeastern New Hampshire and northeastern Massachusetts.

## Physical Production Relationships In Broiler Growing

The integrator, in developing a schedule of payments to growers, considers a number of factors. The two most important productivity indices commonly used in contract production to determine grower returns are feed conversion ratio — pounds of food consumed divided by pounds of meat produced — and rate of weight gain or weight at time of processing.

The purposes of this section are twofold. First the records of several large integrated broiler growing operations provide a basis for the development of physical coefficients for use in the economic analysis of this study.

Second, there are indications that such factors as breed, flock size, and age at time of sale influence both of the important producer income determinants — feed conversion and weight. This section analyzes the effects of these factors.

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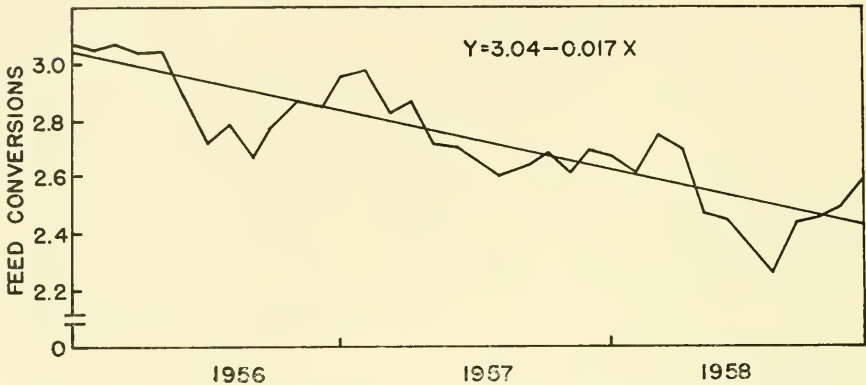
<sup>3</sup> These records were collected by G. B. Rogers and E. T. Bardwell of the New Hampshire Agricultural Experiment Station in connection with other studies, and were made available for use in this study.

## FEED CONVERSION

### Trend and Seasonal Variation in Feed Conversion

The development and improvement of high-energy broiler rations, the breeding of improved broiler strains, and better management of broilers have had a profound effect on the trend of feed conversion ratios. Figure 1 illustrates this trend over the 3-year period 1956-1958 during which

Figure 1. Feed Conversion Ratios of 673 Broiler Flocks  
Averaged by Month of Sale, 1956-1958



the amount of feed required to produce a pound of meat decreased by 0.612 pounds or approximately 20 percent. Statistical tests indicate that the conversion ratios of flocks sold during December, January, February, March, and April during the 3-year period differed significantly from those sold during July and August.<sup>4</sup>

### Breeds and Feed Conversion

Feed conversion ability is commonly used as a basis for evaluating the meat-producing efficiency of the various broiler breeds. Two statistical tests were made to determine whether breeds might differ in this respect.

The first test consisted of comparing the feed conversion ratios of flocks of two breeds sold over a 15-month period by growers of an integrated firm. No significant difference was found.<sup>5</sup>

The second test consisted of comparing feed conversion ratios of seven breeds entered in three broiler trials.<sup>6</sup> The broilers in each trial were subject to the same management conditions, which was not the situation in the first test. Thus, the differences in the ratios in the trials were more reliable for indicating differences in feed conversion ability. However, in this test also no statistically significant difference was found.<sup>7</sup> Thus it was concluded that the breeds tested did not differ in feed conversion ability.

<sup>4</sup> See Appendix Table 1.

<sup>5</sup> See Appendix Table 2.

<sup>6</sup> *The 1958 New Hampshire Broiler Trials*, Department of Poultry Science, University of New Hampshire.

<sup>7</sup> See Appendix Table 3.

## Flock Size and Feed Conversion

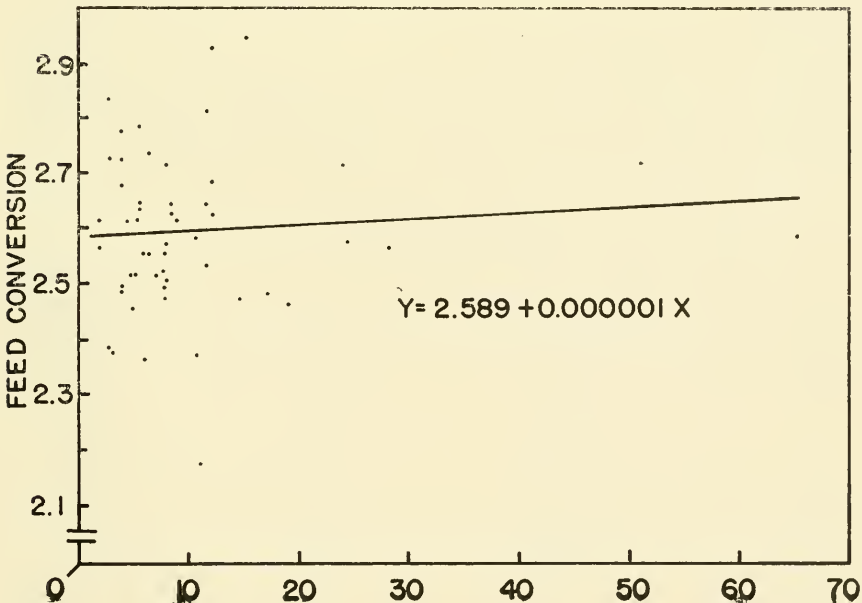
It is often thought that feed conversion becomes poorer as flock size increases and management becomes less personalized. Such an inverse relationship between increasing flock size and feed conversion would have an effect on the desirability of size adjustments by contract growers, and thus on income and capital accumulation. A regression analysis was made on the feed ratios of 58 flocks sold over a 3-month period ranging in size from 2,000 to 65,000 broilers. All flocks were produced by growers of a single integrated firm. For these rather homogeneous enterprises, the analysis showed no significant relationship between flock feed conversion ratios and flock size. Figure 2 shows the derived regression for these data.

## Age at Time of Sale and Feed Conversion

Two analyses were made of the effect of variation in age at time of sale on feed conversion. The first test was a regression analysis of feed conversions of 71 flocks of a single breed produced by 22 growers of a large integrated firm. The age of these flocks at time of sale ranged from 65 to 76 days. The regression, illustrated in Figure 3, shows that the ratio becomes poorer the longer the birds are kept.

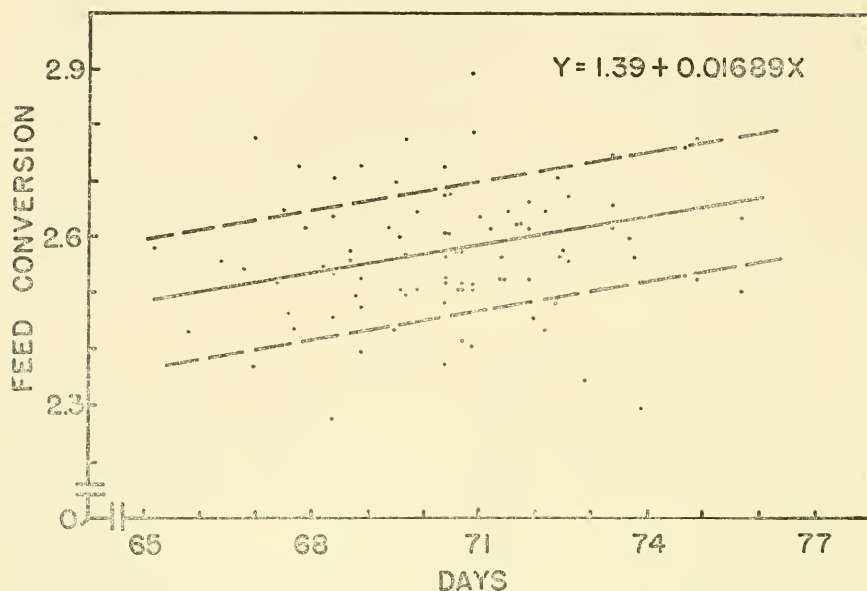
To substantiate the above result, a second test was made using data procured in a broiler test where there was less chance of variation from other influences. These data, summarized in Table 1, show that feed

Figure 2. Relationship of Feed Conversion to Flock Size  
for 58 Flocks Sold During July-September, 1956\*



\* Feed conversion adjusted to eliminate trend. Flock size in thousands.

Figure 3. Feed Conversion Ratios and Age of Flocks at Time of Sale, for one Breed, December, 1956-November, 1957\*



\* Feed conversions adjusted to eliminate trend and seasonal variation.

conversion gets steadily less efficient over the entire length of the growing period.

### Mortality and Feed Conversion

Data collected from the survey of integrated firms were not adequate to evaluate the effect of mortality on feed conversion. There was no information on time or cause of mortality occurring in the flocks.

Table 1. Feed Consumed, Weight in Pounds, and Feed Conversion Ratio for Broilers by Weeks. \*

| Weeks | Feed<br>Pounds | Weight<br>Pounds | Feed per Pound<br>of Total Weight<br>Pounds |
|-------|----------------|------------------|---------------------------------------------|
| 1     | 0.17           | 0.20             | 0.85                                        |
| 2     | 0.47           | 0.39             | 1.21                                        |
| 3     | 0.97           | 0.70             | 1.39                                        |
| 4     | 1.67           | 1.10             | 1.52                                        |
| 5     | 2.59           | 1.55             | 1.67                                        |
| 6     | 3.65           | 2.07             | 1.76                                        |
| 7     | 4.90           | 2.55             | 1.92                                        |
| 8     | 6.30           | 3.00             | 2.10                                        |
| 9     | 7.80           | 3.59             | 2.17                                        |
| 10    | 9.40           | 4.05             | 2.32                                        |

\* Department of Poultry Science, University of New Hampshire.

## The Production Unit and Feed Conversion

Individual production units within an integrated firm were analyzed to determine whether the integrator had succeeded in standardizing the management of these broiler farms when measured by feed conversion ratios of broiler flocks produced. This analysis was made because if no difference existed between production units of a firm, all units could be considered homogeneous and could be given equal treatment by the integrator.

A statistical analysis was made using data from 22 growers producing 71 flocks for a single integrator during one year.<sup>8</sup> The test revealed that a significant difference existed between these production units. Most of the variation was probably accounted for by differences in the quality of grower managerial ability and physical plants within the integrated firm. It would have been greater had it not been for the service men hired to standardize and improve grower practices within the integrated firm.

### GROWTH RATE AND FINISH WEIGHT OF BROILERS

The growth rate and live market weight of broilers are the important factors determining potential output of production units. With a given finish weight, increasing rates of growth over time permit growers to increase annual output.

The finish weight at time of marketing, or average live weight, is also often used in contracts as a determinant of feed conversion. It is often the only physical factor used in determining returns to growers.

### Trend and Seasonal Variation in Weight and the Growth Rate

Figure 4 illustrates the linear trends that have occurred for average weight and age of 678 flocks at time of sale during the 3 years 1956-1958. Average weight increased from 3.274 to 3.555 pounds, an increase of 0.281 pounds. Growing time has decreased from 73.45 to 67.58 days, a decrease of 5.87 days. Using these data a trend was derived for the average daily growth rate for the period. This is illustrated in Figure 5. According to these data, the average growing time for a 3.5 pound broiler decreased from 78.7 to 67.1 days between 1956 and 1958. Assuming that the rate of growth continues to increase, and that consumers will continue to prefer a dressed broiler equivalent to 3.5 pounds live weight, growers have an opportunity to continue to increase flock output per year.

Seasonal variations in growth rates would influence broiler output and therefore income to producers. To determine whether such seasonal variation exists, a statistical analysis was made on the data.<sup>9</sup> The results indicate no significant variation.

### Breed and the Growth Rate

Two statistical analyses were made to determine whether differences exist between breeds in their average rates of growth. In the first analysis, data were used on seven breeds entered in three trials over a 1-year period.<sup>10</sup> With such things as housing, management, and feed be-

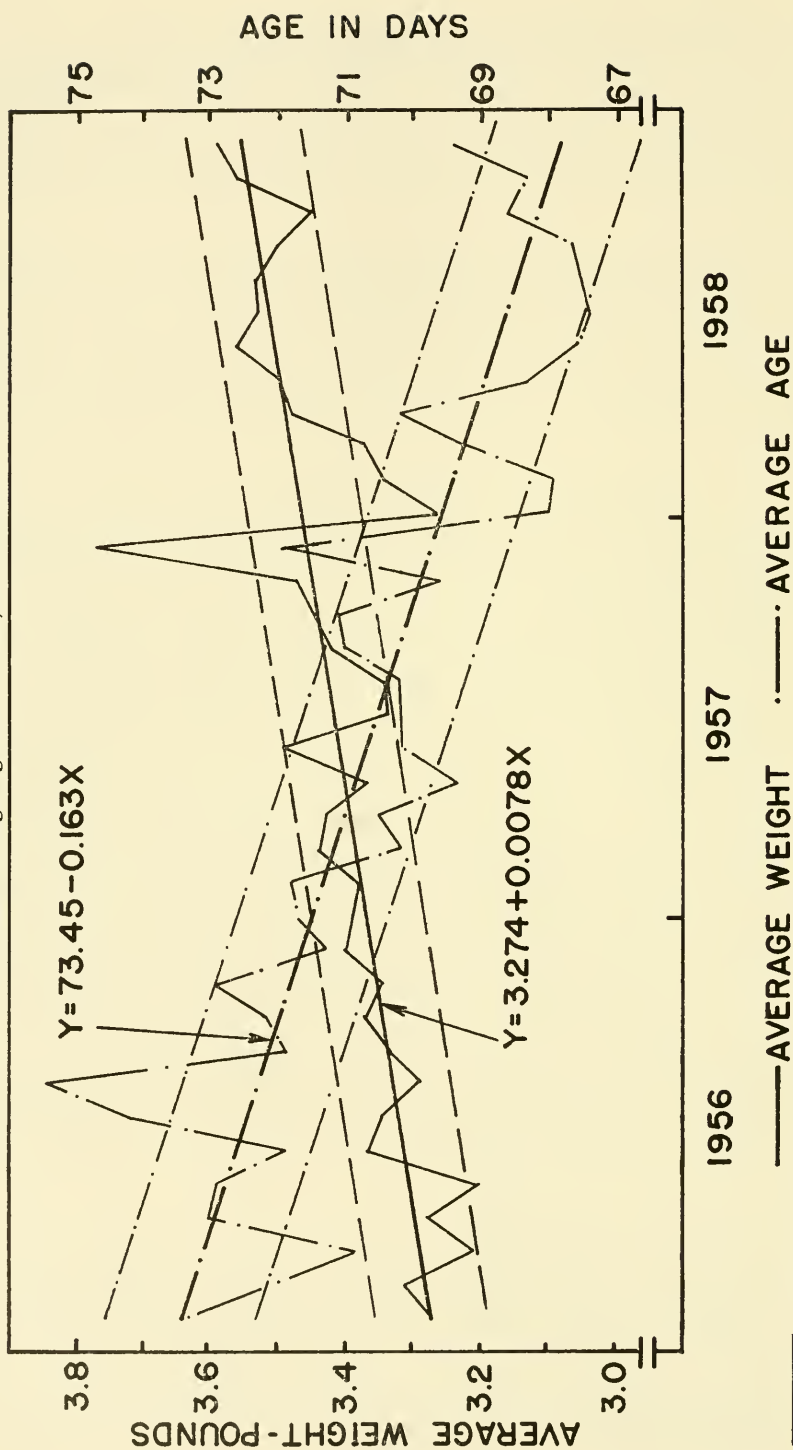
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<sup>8</sup> See Appendix Table 4.

<sup>9</sup> Appendix Table 5.

<sup>10</sup> Appendix Table 6.

Figure 4. Average Weight of Broilers for 678 Flocks Classified by Month of Sale and Average Age When Sold, 1956-1958\*



\* Average weight and age in days weighted by flock size.

ing held constant, the variance analysis revealed significant differences between the breeds.

The second analysis consisted of testing the average growth rates of flocks of the two dominant breeds produced over a 15-month period by the larger of the two integrated firms providing data for the study.<sup>11</sup> This analysis differs from the first in that differences between production units are included, yet it also showed significant difference between breeds.

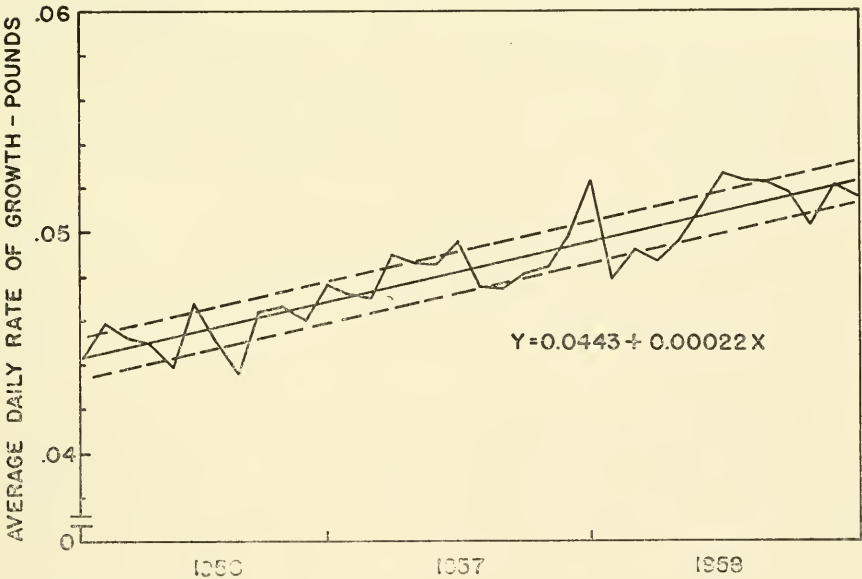
**Flock Size and the Growth Rate**

An inverse relationship between flock size and growth rate would tend to limit the flock size of the production unit. Since differences exist between broiler breeds, flocks of a given breed sold over a three-month period were selected for this analysis. A total of 29 flocks ranging in size from 3,954 to 18,763 broilers raised were used in the analysis. No relationship between flock size and the rate of growth of broilers was found in these flocks.<sup>12</sup> This indicates that further enlargement of flock sizes is possible as long as conditions specified by integrators are adhered to by the growers.

**The Production Unit and the Growth Rate**

The policy of the integrated firm is directed toward standardizing flock management and the level of technology used in producing broilers. Using the average daily rate of growth as a unit of measurement, it is possible to appraise the results of this policy.

Figure 5. Average Daily Rates of Growth for Broilers  
in 678 Flocks by Month of Sale, 1956-1958



<sup>11</sup> See Appendix Table 7.

<sup>12</sup> A Correlation coefficient of 0.034.

Data for this analysis covers 71 flocks of one breed produced by 22 growers over a 1-year period. Analysis of variance of the data indicated no significant differences in the 22 production units.<sup>13</sup> Consequently, these production units producing a single breed are sufficiently standardized to produce a given average weight of bird over a given period of time even though significant differences in feed conditions do exist.<sup>14</sup>

## Institutional Factors Relating to Broiler Growers

The development of a specialized poultry meat industry has changed the structure of the poultry industry. Previously, there were many small farm producers, live buyers, and small city slaughterers. The processing and supply firms resorted to vertical integration. Today, an estimated 95 percent of the broiler growers in northern New England are vertically integrated.

### SHIFTS THAT HAVE OCCURRED IN DECISION MAKING POWER

A considerable number of shifts have occurred in decision-making power as a result of vertical integration. At present, there seems to be little difference between integrators in the degree of decision-making power they possess concerning the production of broilers.

### Variable Inputs

Processor-integrators interviewed indicated that they made all decisions concerning variable inputs once made by the independent broiler grower. The integrators determined what breed of broiler was produced and what types of feed were used. Integrators also negotiated for and paid for the supply of fuel, litter, grit, medicines, and generally, electricity. They also paid for insurance premiums on the broilers. One integrator indicated that he also supplied the disinfectants required for cleaning broiler houses between flocks.

Most of the integrators obtained their supplies of these inputs from other firms. However, several of the large integrators owned and operated hatcheries for a supply of broiler chicks and some owned and operated feed milling facilities which supplied their requirements for feed. Integrators derived some economies through mass purchasing or production of supplies which independent broiler producers were not able to equal.

The contract grower generally supplied very few variable inputs. A few of the larger contract growers in the firms studied hired labor, but most relied on their own and their family's labor. Growers determined how to dispose of the manure during the clean-out period between flocks. They also had to supply water, disinfecting materials, and, in a few cases, electricity.

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<sup>13</sup> See Appendix Table 3.

<sup>14</sup> See Page 9.

## Fixed Inputs

The contract grower supplied all fixed inputs for the production of broilers including buildings, equipment, and his labor. The building was generally a frame structure of wood suitable for broiler or egg production. Equipment included feeders, waterers, bulk feed facilities, and brooders or some other type of heating system. If the grower provided water from the farm, a well and pumping equipment was required.

Integrators have shown very little interest in acquiring ownership of broiler production facilities. In northern New England, however, some of the processor-integrators own a few broiler houses and equipment.

## LEVEL OF TECHNOLOGY OF CONTRACT GROWER PRODUCTION UNITS

Vertical integration has created certain problems concerning the adoption of new technology. Basically, the problem is that the production of broilers is a joint undertaking between a few integrators and many growers. Prior to integration, production decisions were made by the producer. The independent grower was free to decide at which level of technology to operate and when to adopt new techniques. But broiler production now involves two parties who do not always have the same interests.

The conflict of interests became especially acute with the depressed condition of the industry during 1958 and 1959. Expansion in northern New England all but ceased, and integrators became very much interested in reducing costs. The integrator is especially interested in any development that may increase feed efficiency and rate of growth or reduce mortality and the costs of fuel, litter removal, electricity and any other purchased items.

One result of that interest was the decision by some integrators that growers should install central heating systems, house-wall insulation and ventilation systems. Achievement of this level of technology by growers would reduce fuel costs and probably would to some extent improve feed conversion and reduce mortality, thus reducing the integrators' costs. The growers would not use as much labor with central heating, but their capital requirements and fixed costs would increase considerably with no increase in their output. In any case, many of the contract growers insulated houses, and some installed central heat and ventilation systems. Those growers who did not comply were less likely to get contracts during the winter months.

## LOCATION OF SUPPLY AREAS FOR BROILER PRODUCTION

The location of the processing plants for broilers and the policies of the integrators can give some indication of the degree of decision-making power held by them. A processor with an exclusive supply area is in a position to utilize the broiler growers whether he is or is not vertically integrated with them. A processor or integrator that has to share his supply area with another processor or integrator is not in this position. In either case, if good alternatives exist for the resources of the growers, integrators will not be able to exercise as much decision-making power over their operations, and may have to make higher returns to them than would be true where such alternatives do not exist.

Six major processors of poultry were in operation in Maine. All six were vertically integrated with growers or allied with other types of industry that are integrated with growers. There was no wide-scale production of broilers by independent producers in Maine. One major processor was in operation in New Hampshire. This firm did not rely on vertical integration as a major source of broilers but acquired its supply primarily from other integrators or independent producers.

Vermont had one processor. This plant was smaller than those in Maine. Part of the supply of broilers was obtained from integrated growers while the rest was purchased from independent producers. Only one processor was considered from northern Massachusetts. This plant, owned by a cooperative, was vertically integrated with growers until 1959. Since then, this plant has relied on independent producers for a supply of broilers.

Historically, the assembly and transportation of broilers has been a function of the processor or integrator. These firms did not hesitate to go as far as 100 miles for broilers, and such large supply areas for individual firms virtually made all of New England a common source of broilers. However, with the depressed economic conditions of the industry during 1959, integrators adopted some cost-saving methods, one of which was to reduce the supply radius. No doubt, some growers were eliminated from the supply areas of all firms and consequently had to shift their resources to other alternatives.

Figure 6 illustrates 50-mile radius supply areas for the nine processing plants in northern New England which was typical of conditions in 1959.<sup>15</sup> Note that only two firms in Maine were able to gain partially exclusive supply areas. All the firms competed against one or more other firms for a supply of broilers. Thus, a contract grower could readily shift from one integrator to another. Unless all firms cut back, one processor could not reduce payments to growers without expecting to lose them to another firm.

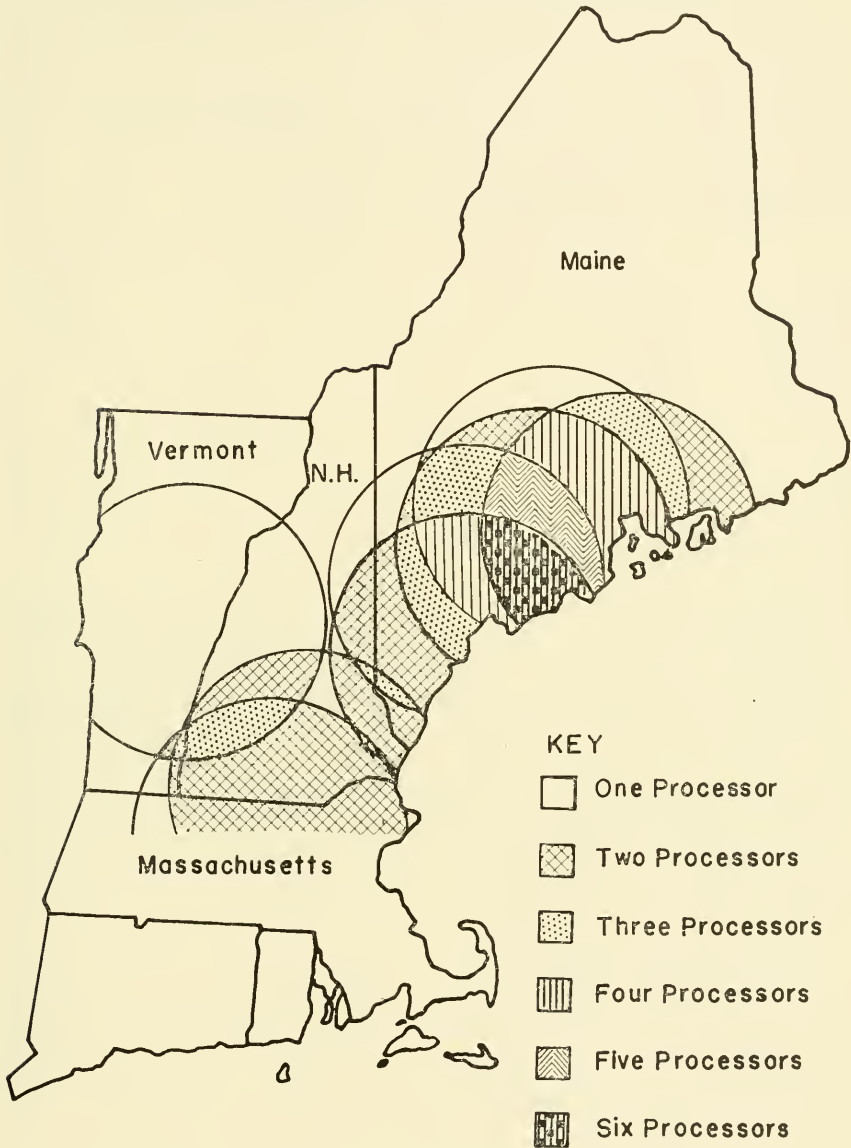
The two firms in New Hampshire and northern Massachusetts had to compete for a supply not only against each other but also with a large group of small live buyers and slaughterers from the metropolitan areas of Boston and surrounding cities and a few of the Maine processors. Furthermore, this same area was also a large source of table eggs and highly industrialized. It is very doubtful that these firms were in a position to dominate even if they resorted to complete vertical integration.

The processing firm in Vermont did possess what could be considered an exclusive supply area. Furthermore, much of the supply area was not industrialized and was not a developed source of market eggs, so few alternatives for growers existed. This area was an intensive milk producing area, and some of the dairymen could produce broilers for this plant as a supplement to their incomes from milk; but it would be difficult for many full-time broiler producers to shift to dairying as a source of income.

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<sup>15</sup>Rogers, G. B. and Bardwell, E. T., unpublished data, New Hampshire Agricultural Experiment Station, 1959.

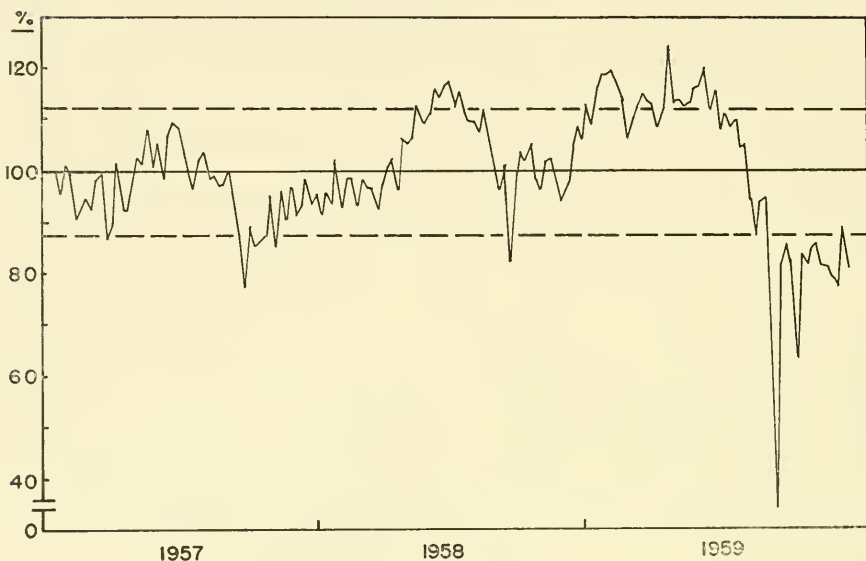
**Figure 6. Fifty-mile-radius Supply Area for Processors in Northern New England, 1959**



#### SEASONAL VARIATION OF BROILER CHICK PLACEMENTS

Consumer preference for broiler meat varies seasonally. Consumers in the Northeast prefer more broiler meat during the summer months than during other seasons of the year. Anticipation of consumer demand by the integrator begins with decisions concerning placement of broiler chicks. Figure 7 illustrates the seasonal variation in chick placements by

**Figure 7. Seasonal Variation in Percent of Broiler Chick Replacements in Maine, by Weeks, 1957-1959\***



weeks for the years 1957-1959 in Maine. Note that the peak month for placements is either May or June. The trough of the placement cycle occurred during the third week of September of each year.

As the amount of time required to produce broilers to market weight decreases, the peak and trough of the placement cycle will shift. The peak will occur later in the spring, and the trough will occur later in the fall. This is based on the assumptions that consumer preference will not shift from the present seasonal pattern, that the market weight presently desired will not change, and that processors cannot reduce the amplitude of the cycle materially by changing the form of some of their output (roosters, for example) during the months when demand for fresh broilers is at a minimum.

The cyclical pattern illustrated in Figure 7 appears to show that the amplitude of the placement cycle was increasing over time; but this is more apparent than real. In 1959, output was expanded considerably in the early months but was followed by a major contraction and adjustments when broiler prices became abnormally low. In New England many feed manufacturers and hatcheries ceased the operation of producing broilers with contract growers during the latter part of 1959.

### **Contract Growers' Rate of Output**

The seasonal fluctuations in broiler consumption reflected in broiler chick replacements made it impossible for all contract growers to produce at a constant rate of output throughout the year. Because their need for growers varied seasonally, integrators devised methods of de-

\* Broiler Chick Report, U. S. Department of Agriculture.

termining which growers to retain on an annual basis and which to use only during the peak of the placement cycle, as well as which growers should be permanently dropped. These decisions were based on evaluation of several factors. One, integrators generally had an elaborate accounting system which included the unit costs for each flock produced. Two, almost every integrator had some method of measuring production efficiency, such as feed efficiency or mortality rate. These factors gave considerable information to the integrator about the grower's managerial ability and technology of his production unit. Three, integrators knew which growers had been willing to accept their management decisions and those who had not.

It was possible to project the linear relationships on changes in weight gains per day and the number of days required to raise broilers to market weight over time as shown earlier, and thus estimate the number of days required to produce broilers to an average weight of 3.5 pounds in future years. Although the derived relationship is linear, the estimates are not continued beyond 1964 in Table 2 because the number of days to produce broilers to 3.5 pounds may be considerably more or less than the projected relationship, depending on developments in technology and management.

Table 2 gives some estimates of the number of flocks of 3.5 pound broilers a grower could produce each year. According to these estimates, the number of days required to produce a flock of broilers to this weight will decline 24 days between 1957 and 1964. With 7-day clean-out periods between flocks and a 2-week period each year for making major repairs and for vacation, a grower could produce 6.35 flocks per year in 1964. By taking less time for cleaning out, and no vacation time, he could produce 7 flocks in 1964. In the 8-year period, it is estimated that occupancy time would decline from 45.7 weeks to 43.8, a period of 2 weeks.

**Table 2. Estimated Number of Days Required to Produce a Flock of 3.5 Pound Broilers and Number of Flocks that could be Produced per Year.**

| Year | Number of<br>Days per<br>Flock * | Number of<br>Flocks per<br>Year † | Number of<br>Weeks Broiler<br>House Occupied |
|------|----------------------------------|-----------------------------------|----------------------------------------------|
| 1957 | 72.3                             | 4.43                              | 45.7                                         |
| 1958 | 68.4                             | 4.65                              | 45.5                                         |
| 1959 | 64.7                             | 4.90                              | 45.3                                         |
| 1960 | 61.2                             | 5.15                              | 45.0                                         |
| 1961 | 57.8                             | 5.41                              | 44.7                                         |
| 1962 | 54.6                             | 5.71                              | 44.4                                         |
| 1963 | 51.4                             | 6.01                              | 44.2                                         |
| 1964 | 48.3                             | 6.35                              | 43.8                                         |

\*Data extrapolated from linear relationships in Figure 4 and 5. Method used: derive number of days to produce flock at middle of each year; derive average weight per broiler at middle of year; determine difference in average weight from 3.5 pounds; divide the difference in weight by the average daily rate of growth for the middle of that year and add or subtract this from the number of days to produce flock. This is an estimate of the number of days to produce a flock of 3.5 pounds live weight.

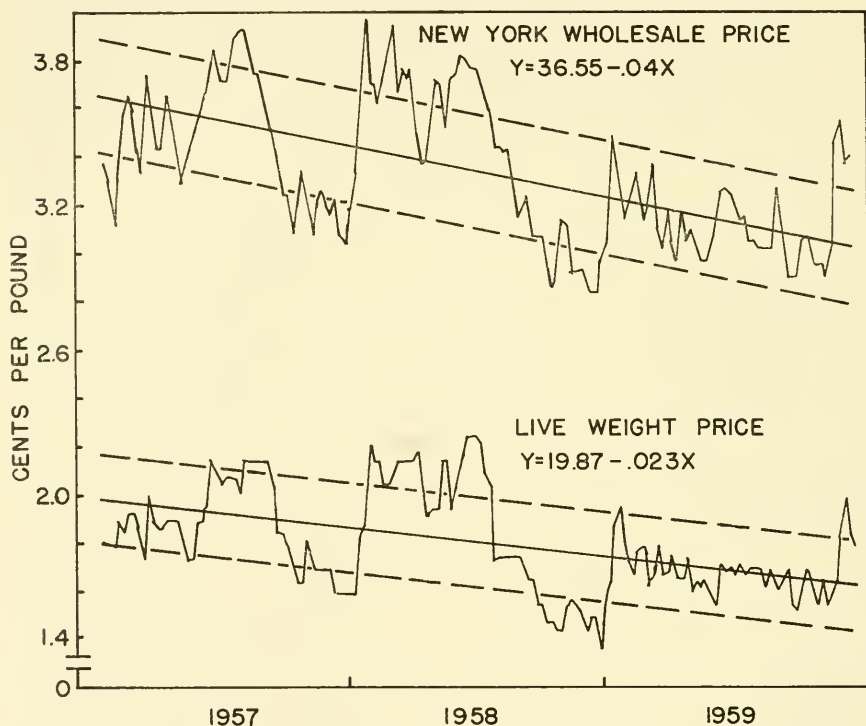
†Number of flocks per year found by adding 7 days to column 2 to allow clean-out period and dividing this into 351 days. Use 351 days to allow 14 days for vacation or making major repairs on facilities.

## TREND AND SEASONAL FLUCTUATIONS IN BROILER PRICES

Broiler prices were one of the basic determinants of returns to contract growers. Processor-integrators in New England usually determined the value of contract-grown broilers by using the quoted wholesale price of eviscerated broilers on the New York market and deducting a margin that covered assembly, processing, distribution, and variations in quality. This value was also used as a bid price by integrators if they required more broilers than were being produced by their contract growers.

Broiler prices in the past few years have been declining. Figure 8 illustrates the linear regressions for the New York wholesale price of Maine

Figure 8. Prices for Live Broilers Sold in Northern New England and Maine Processed Broilers Sold in New York City, 1957-1959\*



processed two and three-quarter pound eviscerated broilers and the live-weight price of broilers in northern New England. The wholesale price has been declining at a greater rate than the live-weight price. This indicates that the integrators have reduced their margins.

Broiler prices fluctuated seasonally, reflecting shifts in consumer preference and an inability of integrators to accurately foresee these

\* Live weight prices, Thursday quotations, for broilers sold in northern New England, *Dairy and Poultry Market News*, Agricultural Marketing Service, U. S. Department of Agriculture, and eviscerated prices, Maine processed two and three-quarter pound broilers, Wednesday quotation, Producers' Price — Current, Urner-Barry Co., New York.

shifts in demand. As a rule, wholesale prices reached a seasonal low in the late fall months and a peak during the summer months. The year 1959 was an exception to this. The live-weight price also fluctuated seasonally. Its movement closely paralleled changes in the wholesale price.

## THE CONTRACT AND METHOD OF DETERMINING RETURNS

The contract is the legal instrument that binds the broiler grower and integrator. It contains various stipulations that the parties have agreed to honor for a certain period of time. It is also stipulated how the contract may be broken by the parties and what penalties may be incurred by the party that breaks the contract.

### Essentials of a Workable Contract<sup>16</sup>

The contract should possess certain basic features. First, it should provide incentives to develop efficiency in broiler production. Second, it should be equitable in terms of sharing risks. Third, it should not be complex and hard to read yet it should be clear in outlining the procedures to be followed by both parties, and should be so written as to prevent misinterpretations that may arise from oral agreements.

The contract should provide a method of determining payments that is sufficiently flexible to permit a grower to increase unit returns through improved management and through adopting new technology recommended by an integrator. The integrator should set some standard unit of measurement applicable to all his growers for determining returns.

The equitable sharing of risks is difficult to obtain, and probably no contract can take account of all the forms of risk that prevail. Price risk should be shared by both parties. If the integrator attempts to absorb all declines in price, he may lose a large sum of money from a precipitous price drop and be forced out of business. This could also force many of his growers out of business. On the other hand, if the integrator attempts to pass along all the price declines to the growers in the form of reduced returns, the growers may be unable to cover annual cash costs, and may shift their resources or go out of business. Therefore, the integrator should establish a system of payment which under no circumstances will reduce annual returns to the grower below the grower's annual cash costs.

Some of the natural risks should be shared while others should not. Losses from a high incidence of an unknown disease, fire, or storms are risks that should be shared since neither party may be directly responsible. However, other losses that result from decisions made by only one of the parties should not be shared. Such risks could include selection of a breed or feed by the integrator that does not perform as expected. Another example would be careless managerial decisions by the grower. Contracts should contain penalty clauses to compensate the party who is injured by such actions.

The contract should be specific in outlining the inputs to be supplied by each party, method of determining grower payments and dates of

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<sup>16</sup> Roy, E. P., and Thomas, W. P. Jr., *Financing Production and Marketing of Broilers in the South, Part II: Grower Phase*, Louisiana Agricultural Experiment Station Bulletin Number 57, Southern Cooperative Series, June, 1958 P. 45.

payment, production methods to be used, and an arbitration procedure. The contract should also contain any other features required to make it a legal document.

### Types of Contracts Used or in Use

A variety of contracts have been used or are in use in northern New England between integrators and growers. This section will cover the "flat fee", "efficiency", "price-efficiency", and "price" contracts.

*Flat Fee.* The flat fee plan provided for a payment per bird or per square foot of space for each week of the period required to raise the flock. This plan was used extensively prior to 1957. Generally the payment was 1 cent per broiler, or per square foot of house floor space used, per week. However, this contract plan did not provide incentive for a grower to improve his management. A grower who produced at a lower unit variable cost than another grower received the same unit return. Furthermore, the plan did not provide for sharing of price risk, as the integrator absorbed all price fluctuations.

*Efficiency.* This plan provided for a method of determining returns on the basis of some measurement of efficiency. A physical measure, such as feed conversion, was used with a schedule of payments. This plan provided incentive to the grower but failed to provide for a sharing of price risk. Historically, integrators lost money as a result of price declines using this contract.

*Price-Efficiency.* This plan provided a method of determining returns based on the prevailing live-weight market price, cash cost of production, and some unit of physical efficiency. This plan provided incentive to the grower and a method of sharing price risk. The plan generally contained a minimum guarantee to growers usually 0.5 cent per bird or per square foot of house floor space per week.

Feed conversion was the most widely adopted efficiency unit of measurement for this plan. Integrators prepared schedules with different levels of feed conversion and broiler market prices. The grower was paid a minimum return on a weekly basis. The incentive payment, if any, was based on feed efficiency.

However, feed efficiency is not an equitable measurement. It was previously noted that feed conversion had a seasonal cycle which tended to move with but was not related to seasonal fluctuations in the live-weight price. This tended to induce wide variations in returns to growers, the highest returns coming from flocks sold during the late spring and summer and the lowest returns coming from flocks sold in the late fall and winter. The minimum guarantee reduced some of this variation by establishing a floor for returns.

Another price-efficiency plan was the cost-of-production method of determining returns. The incentive payment was determined by deducting the integrator's cost of producing the flock from the value of the flock. The grower and integrator shared any profits on a predetermined basis. If the flock was raised at a loss to the integrator, the grower received only the minimum guarantee. Under these plans, unit returns to the grower ranged from the minimum guarantee to as high as 1 to 1.25 cent per bird or per square foot of house space per week.

*Price.* This plan provided a method of payment determined strictly by the prevailing market price for live broilers. The plan generally con-

tained a minimum guarantee provision. This method of determining returns appeared to reduce grower incentive, and it shifted almost all the price risk to the grower. Returns under this plan were likely to fluctuate much more than in other plans.

## Labor, Capital, and Cost Requirements of Broiler Growers

### UTILIZATION OF LABOR IN BROILER PRODUCTION

The amount of labor used per thousand broilers depends on the length of time required to raise the flock to market weight, the level of management, and the amount of technology in the form of labor-saving equipment. The length of time required to raise broilers to a specific market weight (generally about 3.5 pounds live weight per broiler) does not vary much between growers.

Integrators establish a minimum level of management for contract growers through a program of education and supervision. This consists of verbal or written instructions on what duties a contract grower must perform. These instructions concern such things as type and quantity of equipment to use per thousand broilers, methods of feeding, watering and brooding, management of litter, ventilation, and temperature.

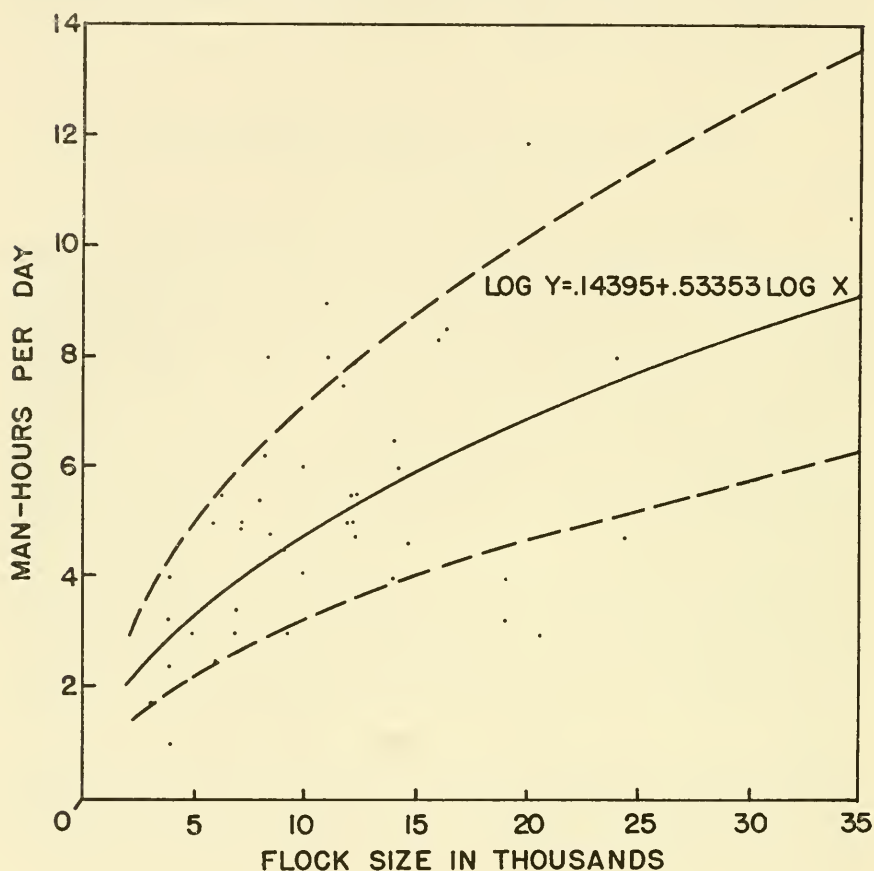
Integrators hire field servicemen to visit contract growers from once every other week to as often as twice a week to check on the progress of the flock and management policy of the grower, take orders for any needed supplies, and make recommendations. Contract growers who fail to adhere to the instructions and recommendations may lose their contracts.

The amount of labor-saving equipment utilized by growers naturally influences the requirement for labor. The more labor-saving equipment a grower uses, the more man-hours are available for increasing the size of his operation or earning income from other alternatives. However, integrators are not necessarily completely in favor of technology that reduces labor costs.

In order to determine the labor requirements for producing broilers, a survey of 50 contract growers producing for two integrators was made. Out of the 50 schedules, 7 could not be used for lack of information. Data were collected on man-hours expended for different chores during two phases of the production period. The first phase, the brooding period, was 14 days. Data were collected on the number of man-hours expended on feeding, watering, brooding, and other chores such as litter management, ventilation, and flock inspection. The second phase was considered to be 56 days. During this period, man-hours expended per day differed from the first period since different types of equipment were generally used. Data collected consisted of man-hours expended for feeding, watering, and such chores as ventilation, flock inspection, and litter management. The 43 farms ranged in size from 3,200 to 35,000 broilers per flock.

Figure 9 illustrates the total number of man-hours expended per day during the first phase. There is considerable dispersion around the regression, which indicates wide variation in management and/or technol-

Figure 9. Man-hours of Labor Expended per Day for Production units of Various Sizes During the First Phase of the Production Period



ogy. The number of man-hours expended per day per thousand broilers decreased with increases in size. It appears that a family unit could care for a flock of approximately 35,000 birds in this phase. With 35,000 broilers, two-thirds of the growers would expend from 6.3 to 13.7 man-hours daily.

Table 3 shows the average number of hours expended for different chores by the 43 contract growers classified by size of flock. The proportion of time used for feeding during the first phase tended to increase with increases in size. The proportion of time spent on brooding tended to decrease, reflecting use of central heating systems with increased size. The proportion of time for other chores was extremely erratic with increases in size. Hand watering of broilers required the greatest amount of time followed by feeding. These two chores required about two-thirds of the labor input for flocks of all sizes.

The use of labor was shifted considerably in the second phase. This resulted from the shift to automatic waterers and the end of brooding chores. Figure 10 illustrates the total number of man-hours expended

Table 3. Man-hours of Labor Utilized per Day for Different Chores during the First Phase of the Production Period \*

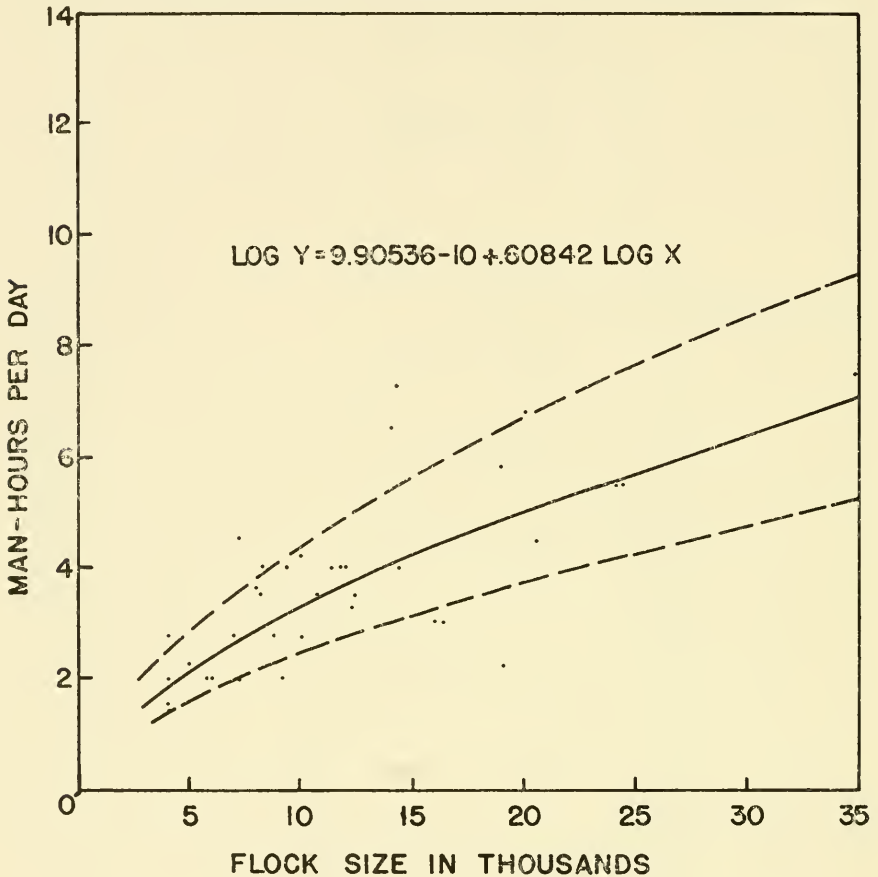
| Size of Flock<br>(thousands) | Average<br>Size<br>(thousands) | Feed            |              | Water           |              | Brood           |              | Other †         |              | Total           |              |
|------------------------------|--------------------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|
|                              |                                | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent |
| 0-4.9                        | 3.8                            | 0.5             | 19           | 1.5             | 57           | 0.4             | 15           | 0.25            | 9            | 2.65            | 100          |
| 5.0-9.9                      | 8.1                            | 1.5             | 27           | 1.9             | 35           | 0.9             | 16           | 1.2             | 22           | 5.50            | 100          |
| 10.0-14.9                    | 12.1                           | 1.8             | 28           | 2.4             | 38           | 1.4             | 22           | 0.8             | 12           | 6.40            | 100          |
| 15.0-19.9                    | 17.6                           | 1.6             | 23           | 2.4             | 34           | 0.0‡            | 0            | 3.0             | 43           | 7.00            | 100          |
| 20.0-35.0                    | 24.9                           | 3.1             | 38           | 2.9             | 36           | 0.5             | 6            | 1.6             | 20           | 8.10            | 100          |

\* Based on 43 contract growers, 1958.

† Includes flock inspection, ventilation, litter management, etc.

‡ All units possessed automatic central heat systems.

Figure 10. Man-hours of Labor Expended per Day for Production Units of Various Sizes during the Second Phase of the Production Period



per day by the 43 contract growers during the second phase. There is much less dispersion about the logarithmic regression than in the first phase, indicating less variation in management and/or technology. However, the number of man-hours expended per day per broiler decreased with increases in flock size. There is no doubt that a family unit could produce at a level of 35,000 broilers per flock, or that it could produce on a still bigger scale if the first phase did not tend to be a restriction.

Table 4 shows for the second phase the average number of man-hours expended on different chores by growers in different size ranges. The proportion of time spent on feeding remained relatively constant as flock size increased, taking almost two-thirds of the labor input. Watering required a rather erratic proportion of the total man-hours with increased size, although the proportion of man-hours tended to increase. The proportion of time spent on other chores tended to decrease with increased size.

These analyses indicate two specific areas open to changes in technology to reduce labor requirements. Growers have indicated a desire to

Table 4. Man-hours of Labor Utilized per Day for Different Chores during the Second Phase of the Production Period \*

| Size of Flock<br>(thousands) | Average<br>Size<br>(thousands) | Feed            |              | Water           |              | Other †         |              | Total           |              |
|------------------------------|--------------------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|
|                              |                                | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent | Hrs.<br>per day | Per-<br>cent |
| 0-4.9                        | 3.8                            | 1.2             | 67           | 0.2             | 11           | 0.4             | 22           | 1.8             | 100          |
| 5.0-9.9                      | 8.1                            | 2.1             | 60           | 0.7             | 20           | 0.7             | 20           | 3.5             | 100          |
| 10.0-14.9                    | 12.1                           | 3.0             | 64           | 1.1             | 23           | 0.6             | 13           | 4.7             | 100          |
| 15.0-19.9                    | 17.6                           | 2.3             | 61           | 1.0             | 26           | 0.5             | 13           | 3.8             | 100          |
| 20.0-35.0                    | 24.9                           | 4.2             | 64           | 1.0             | 15           | 1.4             | 21           | 6.6             | 100          |

\* Based on 43 contract growers, 1958.

† Includes flock inspection, ventilation, litter management, and so on.

switch to automatic feeding during the second phase. They would also like to shift to automatic watering during the first phase. These two developments together would permit major increases in size of flock that could be handled by family units.

Adoption of labor-saving technology, and continued emphasis on larger production units by integrators, will lead to larger production units in the future. The 35,000-bird unit of today will probably be replaced by the 50,000-bird unit.

### CAPITAL REQUIREMENTS

R. F. Saunders conducted a study of broiler growers in Maine in 1955. He found an average investment of \$1.20 per bird capacity.<sup>17</sup> The practice at that time was to allocate one square foot of house space per broiler. The building required the greatest investment, averaging 96 cents per square foot for new construction and 78 cents per square foot for remodeled barns. Investment in equipment averaged 35 cents per square foot. Thus, average investment ranged from \$1.13 to \$1.31 per square foot.

Since 1955, investment per square foot has been increasing. The integrators have reduced variable costs by having growers improve housing and technology. Furthermore, growers want to substitute equipment for labor in order to have more time for other purposes. These forces should continue in the future, causing investment per square foot to increase further.

However, there is considerable variation among growers in amount of investment. This variation is partly caused by the many alternatives the grower has in deciding what types of equipment and quality of material to use. Size of investment is also affected by whether the grower uses family labor to build the house or hires the labor, and by the level of technology and design selected. For purposes of this study, it was assumed that a capital investment of \$1.20 to \$1.80 per square foot is required at the present time.

### CONTRACT GROWER EXPENDITURES

Under present arrangements between contract growers and integrators in northern New England, the contract grower is responsible for the fixed costs of broiler production while the integrator is responsible for the variable costs. By definition, fixed costs are those expenses that do not change with the volume of output. Variable costs are those costs that do change with output. If the production unit remains idle for a year, there are no variable costs, but there are fixed costs.

Expenditures of contract growers can be classified as follows: (1) family living allotment or consumption allowance, (2) taxes, (3) building and equipment insurance, (4) maintenance and repair, (5) depreciation, (6) interest on the growers' own capital investment and (7) debt retirement and interest on borrowed investment capital. These cost items will be discussed individually below.

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<sup>17</sup> Saunders, R. F., *Contract Broiler Growing in Maine*, Maine Agricultural Experiment Station Bulletin 571, May 1958, p. 18.

## Family Living Allotment

The family living allowance is that portion of income used for consumer goods. Such goods include food, clothing, furniture and furnishings for the home, medical care, personal care, life and accident insurance premiums, newspapers, magazines, books, educational expenses, amusements, contributions and state and federal income taxes.<sup>18</sup>

There are definite relationships between changes in income and changes in family consumption. As the level of income increases, family consumption increases, but at a slower rate. However, when the level of income falls, family consumption declines, but at a slower rate. Thus, it is possible to conceptualize a long-run consumption function for a family which will indicate the changes in the level of consumption accompanying changes in the level of income. But if the family has had a level of income that has remained constant for some time so that the level of consumption has also become constant, a decline in the level of income will not result in a fall in consumption based on the long-run consumption function. Instead, a new consumption function much flatter in slope is developed. On this function, consumption declines at a much slower rate than income. In Figure 11, the long-run consumption function is the line AB. The short-run function, A'b, indicates the new relationship between consumption and declines in the level of income.

The short-run function with its rather flat slope is a result of the family unit attempting to maintain its accustomed standard of living. Generally, consumers will resist lowering their standard of living even if it requires using past accumulations of savings.

It is not possible to establish a single consumption function that will be representative for all broiler grower families. For example, two growers receiving identical annual incomes may spend different amounts on consumption. This difference is a result of many factors. First, the two families may have different habits and standards, so that one family consumes more than another. Second, the two families may live in different communities, and the communities may differ in standard of living. Since consumer behavior is considered to be interdependent, the families in the community with the higher standard of living will spend more of their income to attain and maintain that standard of living.<sup>19</sup> Although Duesenberry only used urban families in his development of the interdependence theory, there is little reason to think that rural families behave differently. Third, the size of the family will also influence the amount of income used for consumption. Although there are a great many other factors involved in explaining consumer behavior, the three mentioned above assist in explaining the difficulty of determining a consumption function for broiler growers as a group. From the evidence presented by studies on farm budgets, family living expenditures appear to be the least flexible item when changes in income occur.<sup>20</sup>

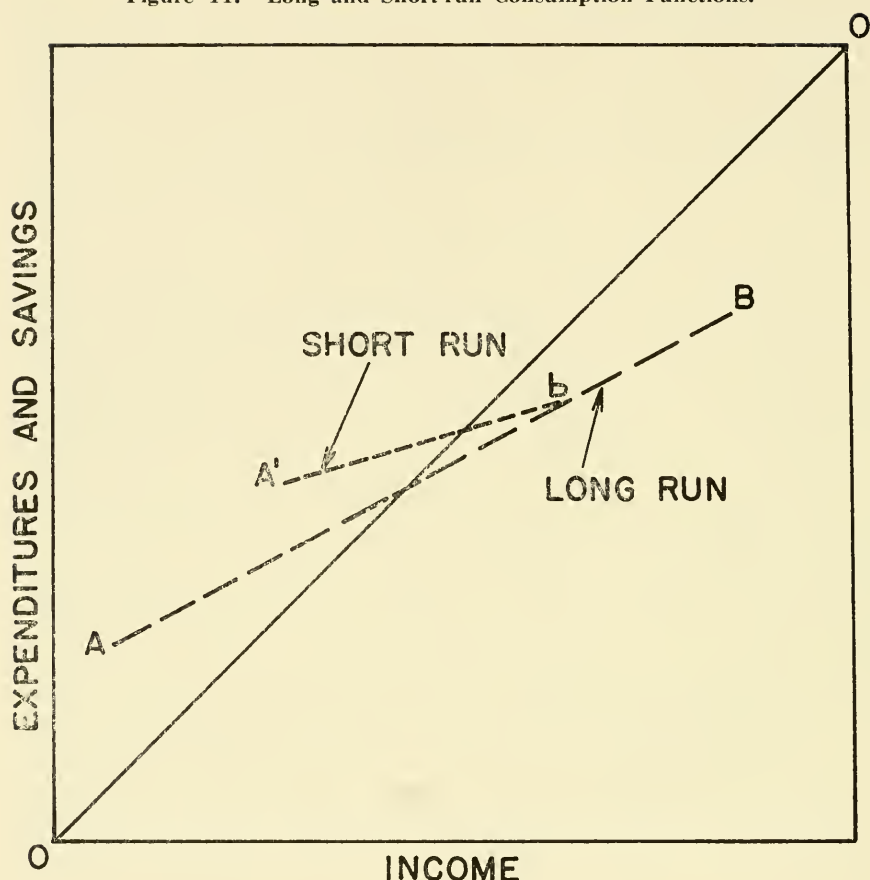
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<sup>18</sup> See Longmore, T. W. and Taylor, C. C., "Elasticities of Expenditures for Farm Family Living, Farm Production, and Savings, United States, 1946," *Journal of Farm Economics*, Vol. XXXIII, February 1951, pp. 1-20.

<sup>19</sup> See Duesenberry, J. S., *Income, Saving, and the Theory of Consumer Behavior*, Harvard University Press, 1949.

<sup>20</sup> Longmore and Taylor, Op. Cit., P. 3.

Figure 11. Long and Short-run Consumption Functions.



### Taxes

State and federal income taxes were included under family consumption allowance. The major tax remaining is the personal property tax. This tax is fixed and does not vary with the level of income so long as the physical production facilities do not change. For purposes of this study property taxes are considered an annual fixed cost.

Under the contract terms used by integrators in northern New England, the grower is responsible for the property taxes on buildings and equipment. The integrator pays any taxes that may be assessed against the broilers. The survey of contract broiler growers revealed a wide variation in the amount of property tax paid per square foot of house. The variation is primarily explained by differences in assessed valuation and local tax needs. No average figure could be derived that would have any meaning in this study.

### Insurance

The contract grower is responsible for making decisions on the amount of insurance to carry on his buildings and equipment. His decisions on

amount of insurance will depend primarily on the age of these items and their earning power, and the amount of the mortgage, if any.

If the firm is earning a high level of net revenue and the outlook for the future is favorable for continued high returns, the contract grower will want to carry sufficient insurance to protect the earning power from loss. However, declining earning power and unfavorable future expectations will tend to make the property of less value to him or anyone else and induce the grower to reduce insurance premium expenditures.

## **Maintenance and Repair Costs**

Maintenance and repair costs fluctuate from year to year and are dependent on factors such as level of income, age and condition of physical assets, quality of materials used in the building and equipment, decision-making power of the integrator, and age of the grower.

A diminishing level of income will probably influence growers to reduce their repair costs and use the funds for other expenditures. However, when the level of income increases, growers will probably increase expenditures for maintenance and repair, especially on repairs that were postponed during periods of low income.

New production facilities will not require large expenditures for maintenance and repair since they have not had time to deteriorate or be subject to wear. Older facilities that have been subject to these factors will require larger expenditures.

The quality of materials used in construction of the building and equipment will influence expenditures over time for maintenance and repair. The grower who uses materials subject to rapid deterioration and wear will have to expend more for maintenance than the grower that uses materials subject to a slower rate of deterioration and wear.

The integrator generally establishes certain minimum requirements based on the condition of the house and equipment. The grower who fails to maintain these factors in a condition equal to or above these standards will be forced to make expenditures for maintenance and repair or lose his contract.

The grower who is approaching retirement age will tend to save as much of his income as possible for his retirement. Thus, he will reduce expenditures on maintenance and repair, especially if he has no intention of leasing or selling the broiler production facilities.

## **Depreciation**

By definition, depreciation is the cost of time, obsolescence, and wear on the investment items purchased by the grower's capital which cannot be counteracted by repair and maintenance.

Time depreciation is the cost of deterioration from rust, corrosion, and rot. Generally, this rate is small and depends on how long the buildings and equipment will last.

Obsolescence occurs when the present fixed item is made valueless by new technology. Since the development and adoption of technology does not occur at a constant rate, the rate of obsolescence depreciation is difficult to determine.

Wear depreciation will vary with the amount of use of a fixed item.<sup>21</sup> Generally, the more an item is used, the greater the rate of wear depreciation. However, the grower who makes frequent expenditures for maintenance and repair has a lower rate of wear depreciation.

The cost of depreciation is best thought of as a long-run cost in that the business must make and accumulate sufficient capital over time to replace facilities when they are no longer suitable for use. In the short run — that is, over several years — these costs can be deferred. However, over time these costs must be met if the firm is to stay in operation.

## Interest Rate

The interest rate on the grower's capital investment should be equal to the rate he can receive from any institution that offers near liquidity and insured deposits plus some amount equal to the risk involved. At the present time, growers can place money in insured savings banks and receive a four percent rate of return. If the grower desired, he could invest in securities that offer a 5- or 6-percent return, although the risk would be greater and the investment would offer less liquidity.

For growers with 100 percent equity, interest charges like depreciation charges are postponable. Many growers prefer to use these charges for current consumption instead of accumulating capital for future replacement or new investment in buildings and equipment.

## Debt Repayment and Interest on Borrowed Investment

For those growers who have less than 100 percent equity in their broiler production facilities, debt and interest repayment is another cost that has to be considered.

Saunders conducted a survey covering loans to broiler growers in Maine from 1948 to mid-1958 to determine lender experience with broiler house financing by commercial banks in Maine and various Federal Government lending institutions.<sup>22</sup> The loans were used for building or remodeling broiler houses. During the period, 527 loans were made. The average loan was for \$8,386. Fifty-four percent of the loans were for terms of from 5 to 14 years, 12 percent were for terms of less than 5 years, and 34 percent were for terms ranging from 15 to more than 25 years. These loans were to be repaid in the majority of cases on a monthly, semi-annual, or annual basis. Annual interest charges ranged from 5 to 6 percent.

Debt repayment is not an expenditure that can be deferred or reduced in most cases. However, some growers probably could refinance their debt to provide for a longer period of time to repay the loan and smaller periodic payments. Interest charges may be increased or decreased depending on other factors.

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<sup>21</sup> Scoville, O. J., "Fixed and Variable Elements in Calculation of Machine Depreciation," *Agricultural Economics Research*, U. S. Department of Agriculture, Vol. 1, No. 3, July 1949, PP. 69-77.

<sup>22</sup> Saunders, R., *Lender Experience With Broiler House Financing*, Maine Agricultural Experiment Station Miscellaneous Report 79, pp. 3-6.

## Capital Accumulation Potential

### CAPITAL ACCUMULATION WITH CHANGES IN INCOME

Previous analyses indicated that contract growers are subject to many physical, institutional and economic factors that influence their returns or income. The following analyses will show how these factors affect grower income and capital accumulation potential in both the short and the long run.

#### Short-Run Changes in Income

Seasonal variations in feed conversion, broiler prices, and chick replacements are the primary determinants of grower income in the short run or one year. Other factors such as type of breed, age of flock at time of sale, and the production unit affect income of a particular grower whenever the factors differ from those of the majority of growers of the integrated firm.

The short-run analysis requires several assumptions: (1) Broilers are produced on contract throughout the year; (2) The production unit is fixed in size; (3) The grower has no other source of income; (4) The functions shown in Figure 12 cannot be shifted up or down; (5) The grower allocates part of his income from each flock for the once-a-year cash expenses; (6) Expenditure habits have been established at the level of income indicated at position 1 in Figure 12; (7) The historical seasonal variations determined previously in this study for feed conversion, broiler prices and chick placements do not change.

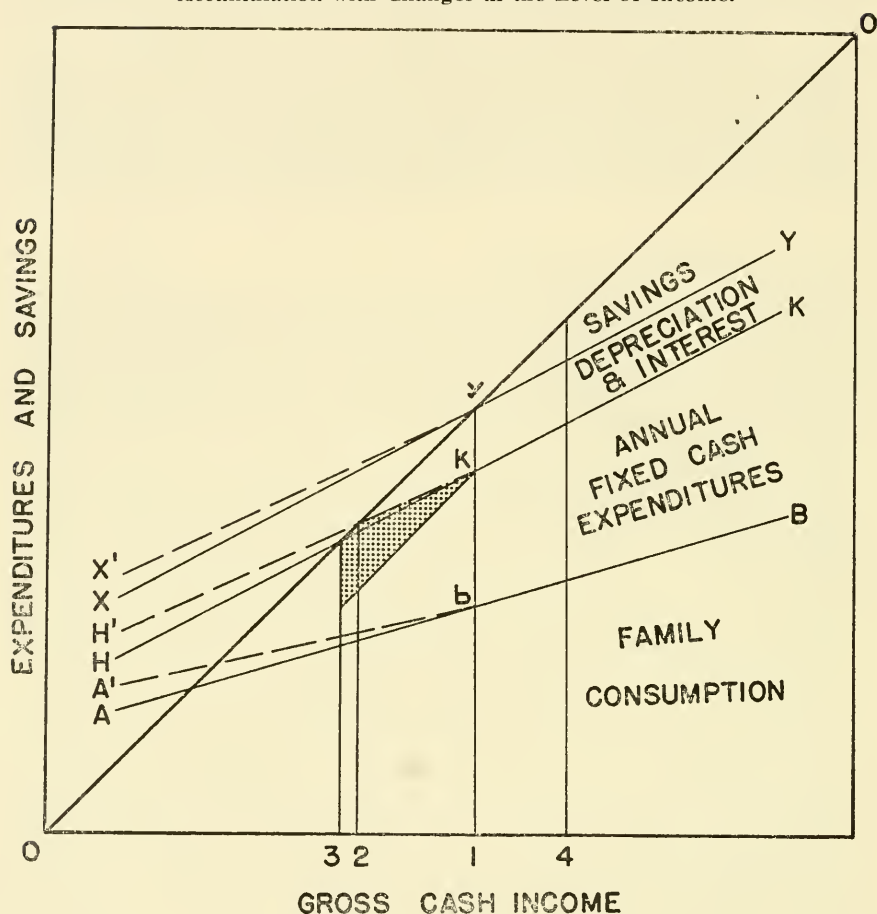
Position 1 in Figure 12 represents grower income in the late summer. At this income level, it is assumed that income is sufficient to meet all cash expenditures and provide for adequate accumulation of capital in the form of depreciation and interest. During the fall, income declines to position 2, since rate of feed conversion, broiler prices and chick placements by integrators are declining, thus reducing the grower's potential output. Family consumption declines along the short-run consumption function,  $A'b$ , and cash expenditures decline along the  $H'k$  function. Income is just sufficient to meet family consumption and cash expenditures, leaving no income for capital accumulation. The shaded area in Figure 12 shows the proportion of cash expenditures paid from income that should have been accumulated.

During the winter, income falls to position 3, since rate of feed conversion continues to decline although broiler prices and placements have started to increase. Income is less than cash expenditures, requiring the use of previous accumulations of capital to cover the difference.

In the spring and summer, income increases to position 4. Improved feed conversions and broiler prices and increased chick placements cause the increase. Expenditures have increased along the functions but income is sufficient to accumulate capital at a rate that will recover losses during the fall and winter.

This example shows how capital accumulation varies in the short run. However, this is not necessarily typical for all growers. Variations would exist for particular growers reflecting their particular or atypical conditions.

Figure 12. Relationship of Various Expenditure Functions and Capital Accumulation with Changes in the Level of Income.



The determinants of grower income — feed conversion, broiler prices and chick placement — were discussed earlier. Conditions in the future could alter these short-run cycles to the extent that growers may be able to accumulate more capital out of income in other seasons of the year.

### Long-Run Changes in Income and Expenditures

The long-run trends of income and expenditures are the essential factors in determining the stability of the broiler industry. In the long run income must be sufficient to allow contract growers to maintain or improve their standard of living, pay recurring business expenses, and accumulate sufficient capital to replace worn-out physical facilities. If these conditions cannot be maintained, growers will seek other alternatives either in or out of the poultry industry.

Previous analyses indicated that the factors determining income have developed trends that are not expected to change for some period of

time. One of these determinants, price of broilers, has been declining historically. The potential drop in income from this price decline has been counteracted by improved breeding and nutrition, adoption of labor-saving equipment, and improved management. These changes in efficiency have provided growers with a chance to maintain income and the possibility of expanding capacity to increase income.

The trend in expenditures by growers is an equally important determinant of the stability of the broiler industry. Per capita disposable income and income to industrial workers in northern New England have been increasing and will no doubt continue to increase. This is an indication that the standard of living is improving, a condition that broiler growers also desire to attain. But this requires additional expenditures on the part of the broiler grower which must come from increased income or from income that would be used for capital accumulated out of present income.

Cash business expenditures are also increasing. Integrators are requiring many improvements in the broiler production facilities which increase maintenance, tax, and insurance expenditures. The rate of capital accumulation must also be increased to recover the additional investment. This increase in cash expenses requires increased income if expenditures for consumption are maintained. If income does not increase, income for capital accumulation must be shifted to meet these increased cash expenditures.

The number of feasible alternatives open to growers to increase income is rather limited. Some growers can increase capacity by adopting existing technology that will increase economic efficiency, but only if the integrator will utilize the added capacity. Other growers with available time may increase their incomes by combining a part-time occupation with producing broilers on a part-time basis. Another alternative is to cease broiler production and produce market or hatching eggs. Also, the grower can cease using the poultry production facilities and get full-time work elsewhere.

Figure 12 may be adapted to illustrate changes that take place in the long run. The functions AB, HK, and XY can be shifted up or down in relation to their location in Figure 12. Starting at position 1, the firm is receiving sufficient income to cover all expenditures. With declining income over the long-run, income would be only sufficient to cover cash expenditures at position 2. But if costs and consumption expenditures were forced up, shifting the functions upward, the equalizing position between income and cash expenditures would be reached between positions 1 and 2. This means that income for capital accumulation is shifted to other expenditures and the capital accumulation potential disappears with decreasing income and constant or increasing expenditures. The ability of the grower to reduce expenditures and maintain capital accumulation with decreasing income is not realistic with present trends in costs and consumer behavior.

In the second case, income is assumed to remain stable and the firm's income and expenditures are equalized at position 1. In the long run, the functions AB, HK, and XY are most likely to be shifted upward with the new equilibrium being established at position 4. The grower is forced to shift income designated for capital accumulation to other expenditures.

The situations illustrate the decline of capital accumulation ability with various relationships between income and expenditures. It is also possible to visualize a case where income is increasing but at a slower rate than expenditures. These situations will eventually lead to growers making one of the adjustments mentioned previously. If the growers cannot improve upon the economic efficiency of contract broiler production, they will seek other alternatives which will result in the decline of the broiler industry in an area.

#### METHOD OF COMPUTING CAPITAL ACCUMULATION

The method used in this analysis to determine the capital accumulation potential of broiler farms differs from the conventional method of individual farm accounting. For a farm with 100-percent owned equity, the conventional method deducts computed depreciation, computed interest charges on capital, and cash business expenses, leaving a residual called "return to labor." If some farm capital is borrowed, the institutional debt repayment schedule must also be taken into account if a true picture of money available for family consumption expenditures is to be given.

The method adopted for this analysis assumes that family income and business costs, which are the variable costs associated with plant operation, have the priority on income. After deducting these two items from gross income, the residual is available for capital accumulation. The precise method used in transposing this annual income flow available for capital accumulation, is synonymous with the debt retirement schedule of most agricultural lending institutions. It differs only in the mechanics of solution. It solves for the time periods required to accumulate the six sums as related to the annual income residuals.

Some of the advantages of this method are:

1. It does not require the estimation of depreciable life of poultry buildings, nor does it involve the estimation of construction costs of the several plants or purchase value of existing facilities.
2. It enables a manager to estimate the possible investment in plant which can be either repaid to a credit source or recouped if owned equity, when related to his personal time horizon and to his selection of anticipated coefficients and prices.

The disadvantage of this method is that it assumes the building facilities have no value at the end of the time period. This neglect of salvage value may not be serious in an industry such as broiler production which is in technological transition.

The method used solves for the number of years to accumulate a selected sum of capital based on the annual net return. Interest charges are treated as a cost to the grower whether he invests owned capital or borrows capital. Interest is treated in this fashion because the grower has an opportunity to invest his capital in some other alternative. The return he could receive from the best alternative use of his capital is an opportunity cost and must be included as a cost to his broiler operations.

The mathematics involves determining a factor for present value. This is derived by dividing the selected capital accumulation figure by the annual net income. Using a set of tables that give present value factors

as related to time, the number of years to accumulate the capital is determined.<sup>23</sup>

## DEFINITION OF COEFFICIENTS AND OTHER CONDITIONS

### Flock Size

Four model sizes are used in the budget analyses. These models have flock capacities of 10,000, 20,000, 35,000 and 50,000 broilers and are identified as models A, B, C, and D respectively. It is assumed that all models can be operated with existing family labor at present or in the case of model D, in the near future.

### Technology

All models are assumed to have the same standards of technology. Buildings are constructed of the same materials, are insulated and centrally heated, and contain bulk feed facilities. Feeding is accomplished manually in both growing phases, and watering is automatic in the second phase. The ratio of growing equipment such as waterers and feeders per thousand broilers is constant for all models. The number of square feet per broiler housed is 0.8. Thus, the models have 8,000, 16,000, 28,000, and 40,000 square feet of house space respectively.

### Average Payments to Producers

Three different levels of producer payments are used in determining annual total revenues for the models. The unit of measurement is in cents per bird per week housed. This measure is used because almost all payment formulations can be converted to this basis.

The highest payment is 1.0 cent per bird per week. This is a rate that the more efficient growers can receive from an integrator. The second payment is 0.75 cent per bird per week. This is a payment quite common to the industry. The lowest payment is 0.5 cent per bird per week, and is the minimum guarantee payment stipulated in many contracts.

### Level of Output

Three different levels of output are considered within the production possibilities of the model unit.<sup>24</sup> The highest level is 5.15 flocks per year requiring 45 weeks to produce, the second level is 4.0 flocks per year requiring 35 weeks; and the lowest level is 3.0 flock per year requiring 26.2 weeks.

### Family Consumption Expenditures

Several different levels of expenditures are used in developing the budgets. For models A and B, annual expenditures are \$3,600 and \$4,500. The figure of \$3,600 is the approximate average wage level of industrial workers in northern New England.<sup>25</sup> The figure \$4,500 reflects expectations of future consumption expenditures.

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<sup>23</sup> Grant and Ireson, *Principles of Engineering Economy*, 4th Edition, Ronald Press, New York, 1960.

<sup>24</sup> See estimates of flock production for 1960 in Table 2.

<sup>25</sup> Employment and Earnings, U.S. Department of Labor, Vol. 6, No. 11, May, 1960.

Models C and D assume expenditure levels of \$5,000 and \$6,000. These levels are higher because gross income is higher than in the other models, and there is a relationship between gross income and consumption expenditures.

### **Annual Cash Business Expenditures**

Annual cash business expenses of maintenance, taxes, and insurance, as derived from the survey of broiler growers, amounts to an average of 7.0 cents per square foot. This figure is used in the analysis for all models since these costs are a function of size. A higher figure of 10.0 cents per square foot is also used to reflect increased costs in the future for maintenance, taxes and insurance.

### **Depreciation**

Neither depreciation nor debt repayment are included as costs to be deducted in this type of analysis. Instead, these payments are part of the residual available for capital accumulation after deduction of expenditures for consumption and business costs. These residuals are used to determine present value factors of several capital sums and how long it would take to accumulate these amounts of capital.

### **Interest**

Interest is charged at a rate of five percent for capitalization purposes. This approximates the return that growers could receive by investing in other alternatives. This figure also approximates the interest charge that a grower would have to pay to borrow capital to invest in broiler producing facilities. In terms of conventional farm accounting procedures, this interest rate is synonymous with the charge for interest on investment.

### **Capital Accumulation Potentials**

Six capital accumulation quantities were selected to solve for the time periods required to accumulate sums by the four models. The selected sums range from \$0.50 to \$3.00 per square foot of house space at 50-cent intervals. This range includes most feasible purchase or construction investments per square foot, and additional capital accumulation that may accrue at a given interest charge.

### **Plant and Equipment Investment Costs**

In a previous section the investment costs for buildings and equipment for broiler production were discussed. The range of cost per square foot typically is between \$1.20 and \$1.80. These amounts are used only as guidelines in this study.

### **Time Required to Accumulate Capital**

The time periods required to accumulate the selected capital sums are the unknowns to be determined. Each investor makes his own decision

concerning how long he wants to be in the broiler business. He wants to recover his investment before this period ends.

Historically, many factors have influenced the competitive position of broiler growers in the several commercial broiler regions of the United States. These changing conditions influence both prices paid and prices received and introduce uncertainty and risk for the individual grower. This dynamic condition is expected to continue. Therefore, it is desirable to consider the time required for growers to accumulate capital under various sets of conditions. For purposes of this study, time to accumulate the various sums is expressed to the nearest year from 1 to 34 years and to the nearest fifth year from 35 to 100 years.

### **Derivation of Net Income**

Annual net income for the four models are based on the previously described coefficients. First, total annual revenues are determined for each model by using all assumed combinations of house occupancy time and returns per bird per week. Total revenues are shown in Table 5. Second, all combinations of family and business expenditures are deducted from the total revenue, leaving a net for capital accumulation or a deficit. Each model has 36 such combinations. Table 6 shows annual net revenues or deficits.

## **ACCUMULATION POTENTIALS AND TIME REQUIRED FOR THE MODELS**

### **Model A**

As a full-time operation, this model has no accumulation potential except in one situation. With payments at a maximum, house occupancy time at a maximum, and expenditures at the lowest levels, this model can accumulate 50 cents per square foot in 18 years. It appears that this capacity unit will not be replaced in the future except on the basis of being used to supplement another source of income. However, integrators do not particularly desire part-time growers or units of this capacity.

### **Model B**

Table 7 shows the time periods required to accumulate the selected sums of capital. With payments at the lowest level, this unit does not have an accumulation potential. With payments at 0.75 cent per bird per week, this unit has to maximize house occupancy time and minimize expenditures to accumulate between \$1.50 and \$2.00 a square foot within a 30-year period. Higher expenditures decrease the amounts of capital that are accumulated to \$0.50 to \$1.00, and this requires 20 to 25 years. Payments at the highest level allow capital accumulation of \$3.00 per square foot in 35 years with expenditures and occupancy time maximized. When occupancy time is reduced to 35 weeks per year, \$1.50 to \$2.50 per square foot is accumulated in a 15 to 45 year period, but expenditures have to be maintained at lower levels.

Replacement of this capacity unit appears doubtful unless growers can supplement income from broilers with income from a part-time occupation. Integrators have not displayed any objection to this size unit, but prefer growers on a full-time basis. There are not enough situations which permit the accumulation of capital to replace this unit based on new construction cost estimates.

Table 5. Annual Gross Incomes to Models with Various House Occupancy Times and Returns per Bird per Week.

|                                                            |       | Model                |       |           |        |
|------------------------------------------------------------|-------|----------------------|-------|-----------|--------|
|                                                            |       | B                    |       | C         | D      |
| A                                                          |       | Weeks house occupied |       |           |        |
|                                                            |       | 35                   | 45    | 26.2      | 45     |
| 45                                                         | 35    | 26.2                 | 45    | 35        | 26.2   |
| Average return at 0.5 cent per bird per week               |       |                      |       |           |        |
|                                                            |       |                      |       | (dollars) |        |
| 2,250                                                      | 1,750 | 1,310                | 4,500 | 3,500     | 2,620  |
|                                                            |       |                      |       | 7,875     | 6,125  |
|                                                            |       |                      |       | 4,585     | 11,250 |
|                                                            |       |                      |       | 8,750     | 6,550  |
| Average return with payment of 0.75 cent per bird per week |       |                      |       |           |        |
|                                                            |       |                      |       |           |        |
| 3,375                                                      | 2,625 | 1,965                | 6,750 | 5,250     | 3,930  |
|                                                            |       |                      |       |           | 11,812 |
|                                                            |       |                      |       |           | 9,183  |
|                                                            |       |                      |       |           | 16,875 |
|                                                            |       |                      |       |           | 13,125 |
| Average return with payment of 1.0 cent per bird per week  |       |                      |       |           |        |
|                                                            |       |                      |       |           |        |
| 4,500                                                      | 3,500 | 2,620                | 9,000 | 7,000     | 5,240  |
|                                                            |       |                      |       |           | 15,750 |
|                                                            |       |                      |       |           | 12,250 |
|                                                            |       |                      |       |           | 9,170  |
|                                                            |       |                      |       |           | 22,500 |
|                                                            |       |                      |       |           | 17,500 |
|                                                            |       |                      |       |           | 13,100 |

Table 6. Annual Net Incomes or Deficits for Four Models Operating at Various Levels of House Occupancy Time, Payments, Consumption, and Cash Business Expenditures \*

| Expenditure levels | Model                                          |       |       |       |        |       |       |       |        |       |
|--------------------|------------------------------------------------|-------|-------|-------|--------|-------|-------|-------|--------|-------|
|                    | A                                              |       | B     |       | C      |       | D     |       |        |       |
|                    | 45                                             | 26.2  | 45    | 26.2  | 45     | 26.2  | 45    | 26.2  | 45     | 26.2  |
|                    | Average payment of 0.5 cent per bird per week  |       |       |       |        |       |       |       |        |       |
| 2†                 | -1910                                          | -2410 | -220  | -1220 | -21 00 | + 915 | - 835 | -2375 | +3450  | -1250 |
| 3‡                 | -2150                                          | -2650 | -700  | -1700 | -2580  | + 75  | -1675 | -3215 | +2250  | -2450 |
| 4                  | -2910                                          | -3910 | -1120 | -2120 | -3000  | + 85  | -1835 | -3375 | +2450  | -2250 |
| 5¶                 | -3050                                          | -3550 | -1600 | -2600 | -3480  | - 925 | -2675 | -1215 | +1250  | -3450 |
|                    | Average payment of 0.75 cent per bird per week |       |       |       |        |       |       |       |        |       |
| 2†                 | -785                                           | -1535 | +2030 | + 530 | - 790  | +4852 | +2228 | - 83  | +8075  | +2025 |
| 3‡                 | -1025                                          | -1775 | +1550 | + 50  | -1270  | +4012 | +1388 | - 923 | +6875  | + 825 |
| 4                  | -1685                                          | -2435 | +1130 | + 370 | -1690  | +3852 | +1228 | -1033 | +7075  | +1025 |
| 5¶                 | -2925                                          | -2675 | + 650 | - 850 | -2170  | +3012 | + 388 | -1923 | +5875  | - 175 |
|                    | Average payment of 1.0 cent per bird per week  |       |       |       |        |       |       |       |        |       |
| 2†                 | + 340                                          | - 660 | +4280 | +2280 | + 520  | +8790 | +5290 | +2210 | +14700 | +5300 |
| 3‡                 | + 100                                          | - 900 | +3800 | +1800 | + 40   | +7950 | +4450 | +1370 | +13500 | +4100 |
| 4                  | - 560                                          | -1560 | +3380 | +1380 | - 380  | +7790 | +4290 | +1210 | +13700 | +4300 |
| 5¶                 | - 800                                          | -1800 | +2900 | + 900 | - 860  | +6950 | +3450 | + 370 | +12500 | +3100 |

\* Based on 0.8 sq. ft. per bird.

† Consumption expenditures \$3600 for A and B, \$5000 for C and D. Cash business expenses based on 7c per square ft.

‡ Consumption expenditures \$3600 for A and B, \$5000 for C and D. Cash business expenses based on 10c per square ft.

|| Consumption expenditures \$4500 for A and B, \$6000 for C and D. Cash business expenses based on 7c per square ft.

¶ Consumption expenditures \$4500 for A and B, \$6000 for C and D. Cash business expenses based on 10c per square ft.

**Table 7. Number of Years to Accumulate Various Sums of Capital at Several Levels of Average Payments, House Occupancy Time, and Expenditures for Model B.**

| Annual Consumer Expenditure | Annual Cash Business Expenditure (cents/sq. ft.) | Weeks of House Occupancy per Year           |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|-----------------------------|--------------------------------------------------|---------------------------------------------|------|------|------|------|---------------------------------------------|------|------|------|------|------|-----|------|------|------|------|------|
|                             |                                                  | 45                                          |      |      |      |      | 35                                          |      |      |      |      | 26.2 |     |      |      |      |      |      |
|                             |                                                  | .50                                         | 1.00 | 1.50 | 2.00 | 2.50 | Capital Accumulation in Dollars             |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                  |                                             |      |      |      |      | .50                                         | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 |
| \$3600                      | 7                                                | Average Payment 0.5 cent per Bird per Week  |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                               |                                             |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
| \$4500                      | 7                                                |                                             |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                               |                                             |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                  | Average Payment 0.75 cent per Bird per Week |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
| \$3600                      | 7                                                | 5                                           | 10   | 18   | 32   | 85   | Average Payment 0.75 cent per Bird per Week |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                               | 6                                           | 15   | 30   |      | 29   |                                             |      |      |      |      |      |     |      |      |      |      |      |
| \$4500                      | 7                                                | 9                                           | 25   |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                               | 20                                          |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                  | Average Payment 1.0 cent per Bird per Week  |      |      |      |      |                                             |      |      |      |      |      |     |      |      |      |      |      |
| \$3600                      | 7                                                | 2                                           | 4    | 7    | 10   | 13   | 17                                          | 4    | 9    | 15   | 25   | 45   | 30  |      |      |      |      |      |
|                             | 10                                               | 2                                           | 5    | 8    | 11   | 15   | 20                                          | 5    | 12   | 23   | 45   |      |     |      |      |      |      |      |
| \$4500                      | 7                                                | 3                                           | 6    | 9    | 13   | 18   | 26                                          | 7    | 18   | 40   |      |      |     |      |      |      |      |      |
|                             | 10                                               | 3                                           | 7    | 11   | 16   | 24   | 35                                          | 12   | 45   |      |      |      |     |      |      |      |      |      |

## Model C

Table 8 shows the number of years needed to accumulate the selected sums of capital. Although higher consumer expenditures were used, this unit has a much more favorable capital accumulation potential than either of the two previous models. However, it possesses little accumulation potential with payments at the lowest level. With payment at 0.75 cent per bird per week, \$2.00 per square foot is accumulated in 18 to 25 years with expenditures kept at the lower levels and occupancy time maximized. Higher expenditures allow an accumulation of \$1.50 per square foot in 16 to 25 years. Decreasing occupancy time to 35 weeks a year reduces the accumulation potentials drastically. Fifty cents to \$1.00 per square foot is accumulated in an 8-to 20-year period, but expenditures have to be kept at lower levels. With payments at 1.00 cent per bird per week and occupancy time maximized, \$3.00 per square foot is accumulated in a 15-to 19-year period with any of the expenditure alternatives. House occupancy time of 35 weeks a year provides an accumulation potential of between \$1.50 and \$2.00 per square foot in a 10- to 22-year period for all expenditure levels. Decreasing occupancy time to 26.2 weeks allows the unit to accumulate between \$0.50 and \$1.00 per square foot in an 8- to 21-year period for several of the expenditure situations.

This model, which provides full employment for a family operation, has satisfactory capital accumulation potentials to provide funds for replacement or for amortization of debt. A unit of approximately this capacity should be adopted by broiler growers to assure a satisfactory standard of living and sufficient capital accumulation.

## Model D

This potential family operation offers considerable capital accumulation opportunities, as shown in Table 9. Fifty cents to \$1.00 a square foot is accumulated between 7 and 35 years for all the expenditure levels with occupancy time maximized and payments at the lowest level. Payments at 0.75 cents per bird per week increase the capital accumulation opportunities. With maximum house occupancy and all expenditure levels, \$2.00 to \$2.50 per square foot is accumulated in a 14-to 21-year period, and smaller amounts in shorter time periods. Decreasing the occupancy time to 35 weeks a year allows an accumulation of \$1.00 to \$1.50 per square foot in a 10-to 21-year period. Further reductions in occupancy all but eliminate capital accumulation. Payments of 1.0 cent per bird per week allow capital accumulation under almost all combinations of occupancy time and expenditures. Three dollars a square foot is accumulated in 11 to 13 years at all expenditures levels with occupancy time at a maximum. Between \$2.50 and \$3.00 a square foot is accumulated in 15-to 23-years for all expenditure levels with occupancy time at 35 weeks a year. Decreasing occupancy time to 26.2 weeks allows an accumulation of between \$1.00 and \$1.50 a square foot for all expenditure levels in 10 to 21 years.

This capacity unit offers more capital accumulation potential than the other models. There is little doubt that it is a capacity that will be adopted once it becomes technically feasible as a family operation.

Table 8. Number of Years to Accumulate Various Sums of Capital at Several Levels of Average Payments, House Occupancy Time, and Expenditures for Model C.

| Annual Consumer Expenditure | Annual Cash Business Expenditure (cent/sq. ft.) | Weeks of house occupancy per year           |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|-----------------------------|-------------------------------------------------|---------------------------------------------|------|------|------|------|------|-----|------|------|------|------|------|-----|------|------|------|------|------|
|                             |                                                 | 45                                          |      |      |      |      | 35   |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 | Capital accumulation in dollars             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 | .50                                         | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 |
|                             |                                                 | Average payment 0.5 cent per bird per week  |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 | 30                                          |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
| \$5000                      | 7                                               |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                              |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
| \$6000                      | 7                                               |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                              |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 | Average payment 0.75 cent per bird per week |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
| \$5000                      | 7                                               | 3                                           | 7    | 12   | 18   | 26   | 40   | 8   | 20   | 60   |      |      |      |     |      |      |      |      |      |
|                             | 10                                              | 4                                           | 9    | 15   | 23   | 40   | 14   |     |      |      |      |      |      |     |      |      |      |      |      |
| \$6000                      | 7                                               | 4                                           | 9    | 16   | 27   | 50   | 17   |     |      |      |      |      |      |     |      |      |      |      |      |
|                             | 10                                              | 5                                           | 13   | 25   | 55   |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 | Average payment 1.0 cent per bird per week  |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
|                             |                                                 |                                             |      |      |      |      |      |     |      |      |      |      |      |     |      |      |      |      |      |
| \$5000                      | 7                                               | 2                                           | 4    | 6    | 8    | 10   | 13   | 3   | 6    | 10   | 15   | 22   | 32   | 8   | 21   | 60   |      |      |      |
|                             | 10                                              | 2                                           | 4    | 6    | 9    | 12   | 16   | 4   | 8    | 13   | 20   | 32   | 60   | 15  |      |      |      |      |      |
| \$6000                      | 7                                               | 2                                           | 4    | 6    | 9    | 12   | 16   | 4   | 8    | 14   | 22   | 35   | 80   | 18  |      |      |      |      |      |
|                             | 10                                              | 2                                           | 5    | 7    | 11   | 14   | 19   | 5   | 11   | 19   | 34   |      |      |     |      |      |      |      |      |

Table 9. Number of Years to Accumulate Various Sums of Capital at Several Levels of Average Payments, House Occupancy Time, and Expenditures for Model D.

| Annual Consumer Expenditure                 | Annual Cash Business Expenditure (cent/sq. ft.) | Weeks of house occupancy per year |      |      |      |      |      |     |      |      |      |      |      | 26.2 |      |      |      |      |      |
|---------------------------------------------|-------------------------------------------------|-----------------------------------|------|------|------|------|------|-----|------|------|------|------|------|------|------|------|------|------|------|
|                                             |                                                 | 45                                |      |      |      |      |      | 35  |      |      |      |      |      |      |      |      |      |      |      |
| Capital accumulation in dollars             |                                                 |                                   |      |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
|                                             |                                                 | .50                               | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | .50  | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 |
| Average payment 0.5 cent per bird per week  |                                                 |                                   |      |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
| \$5000                                      | 7                                               | 7                                 | 18   | 40   |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
|                                             | 10                                              | 12                                | 45   |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
| \$6000                                      | 7                                               | 11                                | 35   |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
|                                             | 10                                              | 33                                |      |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
| Average payment 0.75 cent per bird per week |                                                 |                                   |      |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
| \$5000                                      | 7                                               | 3                                 | 6    | 10   | 14   | 20   | 28   | 4   | 10   | 17   | 29   | 55   | 14   | 90   |      |      |      |      |      |
|                                             | 10                                              | 3                                 | 7    | 12   | 18   | 27   | 45   | 6   | 14   | 27   | 70   |      |      |      |      |      |      |      |      |
| \$6000                                      | 7                                               | 3                                 | 7    | 11   | 17   | 25   | 40   | 5   | 13   | 24   | 55   | 75   |      |      |      |      |      |      |      |
|                                             | 10                                              | 4                                 | 9    | 15   | 24   | 40   | 8    |     | 21   | 65   |      |      |      |      |      |      |      |      |      |
| Average payment 1.0 cent per bird per week  |                                                 |                                   |      |      |      |      |      |     |      |      |      |      |      |      |      |      |      |      |      |
| \$5000                                      | 7                                               | 2                                 | 3    | 5    | 7    | 9    | 11   | 2   | 5    | 8    | 11   | 15   | 20   | 4    | 10   | 17   | 29   | 60   |      |
|                                             | 10                                              | 2                                 | 3    | 5    | 7    | 9    | 12   | 3   | 6    | 9    | 13   | 18   | 25   | 6    | 14   | 27   | 75   |      |      |
| \$6000                                      | 7                                               | 2                                 | 3    | 5    | 7    | 9    | 12   | 3   | 5    | 9    | 13   | 18   | 24   | 5    | 13   | 25   | 55   |      |      |
|                                             | 10                                              | 2                                 | 4    | 6    | 8    | 10   | 13   | 3   | 6    | 10   | 16   | 23   | 33   | 8    | 21   | 70   |      |      |      |

## Summary and Conclusions

The analysis in this study had essentially one objective: to appraise the effect of various technical, institutional, and economic factors on the long-run capital accumulation potential of contract broiler growers in northern New England. Capital accumulation potential is one of the primary factors in determining the future stability of the broiler industry. As long as growers can accumulate sufficient capital to replace facilities as they become useless for production, the industry will remain relatively stable and possibly will expand.

Technology in broiler production has improved a good deal over time. Feed conversions are improving with the development of new feed formulations and strains of broilers. Feed conversion is not a limitation in expanding flock size, but integrators still have to work towards eliminating seasonal variation and standardizing production units in terms of feed conversion. For any one farm, the potential number of flocks of 3.5-pound broilers per year is increasing. Output averaged 4.45 flocks in 1957 and it is estimated that output will reach 6.01 flocks in 1963.

Integration has introduced several new institutional factors that affect broiler producers. Integrators make all decisions concerning the variable inputs as well as some that affect the growers' production facilities. This has led to a conflict of interest which sometimes results in integrators requiring growers to adopt improvements that reduce the integrators' costs but may increase the growers' cost.

Broiler production tends to be located within a 50-mile radius of processing facilities as a result of integrators reducing the size of their areas. This means that production probably will continue to be in southern Maine and New Hampshire and central Vermont, based on present processing plant locations.

Integrators have not been able to stabilize output on a seasonal basis. Output is highest during the summer and lowest during the late fall. Such variation means that only the most efficient growers may produce throughout the year while others produce only part of the year.

Historically, broiler prices have been declining and a further decline is expected. This price decline has resulted in lower payments to growers, although they have become more efficient economically.

Integrators rely principally on a "price-efficiency" contract for determining payments to growers. Growers are paid on the basis of the prevailing price and their efficiency of production in relation to other growers of the integrated operation. These contracts contain a stipulation on a minimum payment equivalent to 0.5 cent per bird per week. The declining price has reduced average payments to 0.75 cent per bird per week, but payments may get as high as 1.0 cent per bird per week.

With existing technology, a family operation can manage and operate a production unit of up to 35,000-broiler flock capacity. The present technology used during the brooding period acts as a restriction to larger capacity units for family operations.

The contract grower has two large expenditure items out of income before capital is accumulated. Income must be expended to maintain some

level of living, and expenditures must be made for cash business expenses such as taxes, insurance, maintenance, and repair.

Analysis of the capital accumulation potential of four different capacity broiler production units revealed that units of 10,000 and 20,000 broiler flocks do not have sufficient accumulation potential to replace themselves when operated as full-time occupations. However, these units are satisfactory as a part-time occupation to supplement income from other sources if this practice remains agreeable to integrators. Larger capacity units, 35,000- and 50,000-broiler capacity, do have sufficient capital accumulation potentials and provide a satisfactory standard of living for growers on the basis of a full-time family operation.

Based on this analysis it would appear that integrators should encourage large production units to assure long-run stability in broiler production capacity. Integrators and growers should work together towards maximizing the occupancy time of the broiler-producing facilities to maximize the growers' annual net income. In the long run, payments should average more than the minimum used in this study to assure growers of a satisfactory level of living and accumulation of capital.

# APPENDIX

**Appendix Table 1. Analysis of Variance of Feed Conversions for 678 Flocks Averaged by Month of Sale, 1956-58\***

| Year | Month |      |      |      |      |      |      |      |      |      |      |      |       |
|------|-------|------|------|------|------|------|------|------|------|------|------|------|-------|
|      | Jan.  | Feb. | Mar. | Apr. | May  | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Sum   |
| 1956 | 2.46  | 2.47 | 2.50 | 2.49 | 2.51 | 2.34 | 2.22 | 2.31 | 2.39 | 2.34 | 2.44 | 2.43 | 28.90 |
| 1957 | 2.56  | 2.61 | 2.46 | 2.51 | 2.40 | 2.40 | 2.37 | 2.33 | 2.38 | 2.44 | 2.37 | 2.47 | 29.30 |
| 1958 | 2.46  | 2.44 | 2.59 | 2.56 | 2.35 | 2.33 | 2.29 | 2.18 | 2.38 | 2.42 | 2.48 | 2.58 | 29.06 |
| Sum  | 7.48  | 7.52 | 7.55 | 7.56 | 7.26 | 7.07 | 6.88 | 6.82 | 7.15 | 7.20 | 7.29 | 7.48 | 87.26 |

| Source of Variation      | Degrees of Freedom | Sum of Squares | Mean Square |
|--------------------------|--------------------|----------------|-------------|
| Total                    | 35                 | 0.3419         |             |
| Months                   | 11                 | 0.2426         | 0.0211      |
| Years                    | 2                  | 0.0068         | 0.0034      |
| Error                    | 22                 | 0.0925         | 0.0042      |
| For months, $F = 5.02$ , |                    | $F = 3.18$     |             |
|                          |                    | .01            |             |
| For years, $F = 0.81$ ,  |                    | $F = 19.43$    |             |
|                          |                    | .05            |             |

\* Feed conversions adjusted to eliminate the trend.

**Appendix Table 2. Feed Conversions of Flocks for two Breeds Averaged by Month of Sale, September 1956 - November 1957. \***

| Month | Breed              |           | Absolute Difference |
|-------|--------------------|-----------|---------------------|
|       | A                  | B         |                     |
| Sept. | 2.69               | 2.62      | 0.07                |
| Oct.  | 2.83               | 2.81      | 0.02                |
| Nov.  | 2.82               | 2.90      | - 0.08              |
| Dec.  | 2.87               | 2.94      | - 0.07              |
| Jan.  | 2.99               | 2.90      | 0.09                |
| Feb.  | 2.98               | 3.03      | - 0.10              |
| Mar.  | 2.82               | 2.86      | - 0.04              |
| Apr.  | 2.81               | 2.86      | - 0.05              |
| May   | 2.77               | 2.69      | 0.08                |
| June  | 2.72               | 2.72      | 0.00                |
| July  | 2.70               | 2.70      | 0.00                |
| Aug.  | 2.63               | 2.65      | - 0.02              |
| Sept. | 2.63               | 2.69      | - 0.06              |
| Oct.  | 2.64               | 2.70      | - 0.06              |
| Nov.  | 2.61               | 2.63      | - 0.02              |
| Sum   | 41.51              | 41.75     | - 0.24              |
| Mean  | 2.767              | 2.783     |                     |
|       | Difference         | 0.016     |                     |
|       | Degrees of freedom | 23        |                     |
|       | Standard error     | 0.0154    |                     |
|       | t - 1.039          | t - 2.048 |                     |
|       |                    | .05       |                     |

\* Feed conversions adjusted to eliminate trend.

**Appendix Table 3. Multiple Analysis of Variance of Feed Conversions for Flocks of Seven Breeds in Three Trials. \***

| Source of Variation | Degrees of Freedom    | Sum of Squares | Mean Squares |
|---------------------|-----------------------|----------------|--------------|
| Total               | 20                    | 0.1025         |              |
| Breeds              | 6                     | 0.0178         | 0.0030       |
| Trials              | 2                     | 0.0704         | 0.0352       |
| Discrepancy         | 12                    | 0.0143         | 0.0012       |
|                     | For breeds, F - 2.50, | F - 3.00       |              |
|                     |                       | .05            |              |
|                     | For trials, F - 29.3, | F - 6.93       |              |
|                     |                       | .01            |              |

\* 1958 New Hampshire Broiler Test, Department of Poultry Science, University of New Hampshire.

**Appendix Table 4. Analysis of Variance of Feed Conversions for 71 Flocks of One Breed Produced by 22 Growers of an Integrated Firm.\***

| Source of Variation      | Degrees of Freedom | Sum of Squares | Mean Squares    |
|--------------------------|--------------------|----------------|-----------------|
| Total                    | 70                 | 1.4083         |                 |
| Between production units | 21                 | 0.6090         | 0.0290          |
| Error                    | 49                 | 0.7993         | 0.0163          |
| Between production units |                    | F = 1.73,      | F = 1.77<br>.05 |

\* Feed conversion adjusted to eliminate trend, seasonal and age variation; feed formulation for all flocks constant.

**Appendix Table 5. Multiple Analysis of Variance of Average Daily Rates of Growth for Broilers by Month of Sale, 1956 - 1958.\***

| Source of Variation | Degrees of Freedom        | Sum of Squares  | Mean Squares |
|---------------------|---------------------------|-----------------|--------------|
| Total               | 35                        | 0.00004998      |              |
| Between years       | 2                         | 0.00000312      | 0.00000156   |
| Between months      | 11                        | 0.00001728      | 0.00000157   |
| Error               | 22                        | 0.00002958      | 0.00000134   |
|                     | Between years: F - 1.16;  | F - 3.44<br>.05 |              |
|                     | Between months: F - 1.17; | F - 2.26<br>.05 |              |

\* Average daily rates of growth adjusted to eliminate trend.

**Appendix Table 6. Multiple Analysis of Variance of Average Daily Rates of Growth for Seven Breeds in Three Trials. \***

| Source of Variation | Degrees of Freedom | Sum of Squares  | Mean Squares |
|---------------------|--------------------|-----------------|--------------|
| Total               | 20                 | 0.00030369      |              |
| Between trials      | 2                  | 0.00001917      | 0.00000959   |
| Between breeds      | 6                  | 0.00024314      | 0.00004052   |
| Error               | 12                 | 0.00004638      | 0.00000387   |
| Between trials:     | F - 2.478;         | F - 3.88<br>.05 |              |
| Between breeds:     | F - 10.470;        | F - 4.82<br>.01 |              |

\* 1958 New Hampshire Broiler Test, Department of Poultry Science, University of New Hampshire.

**Appendix Table 7. Average Daily Growth Rates for Flocks of Two Breeds,  
by Month of Sale, September 1956 - November 1957.**

| Month              | Breed |           | Difference in<br>Pounds per Day<br>per Broiler |
|--------------------|-------|-----------|------------------------------------------------|
|                    | "A"   | "B"       |                                                |
| Sept.              | .0449 | .0470     | — .0021                                        |
| Oct.               | .0474 | .0472     | .0002                                          |
| Nov.               | .0485 | .0460     | .0025                                          |
| Dec.               | .0487 | .0475     | .0012                                          |
| Jan.               | .0456 | .0488     | — .0032                                        |
| Feb.               | .0493 | .0443     | .0050                                          |
| Mar.               | .0495 | .0472     | .0023                                          |
| Apr.               | .0501 | .0486     | .0015                                          |
| May                | .0534 | .0470     | .0064                                          |
| June               | .0496 | .0487     | .0009                                          |
| July               | .0476 | .0468     | .0008                                          |
| Aug.               | .0487 | .0464     | .0023                                          |
| Sept.              | .0490 | .0485     | .0005                                          |
| Oct.               | .0498 | .0492     | .0006                                          |
| Nov.               | .0506 | .0487     | .0019                                          |
| Sum                | .7327 | .7119     | .0208                                          |
| Mean               | .0488 | .0474     | .0014                                          |
|                    |       |           |                                                |
| Difference         |       | 0.00139   |                                                |
| Degrees of freedom |       | 14        |                                                |
| Standard error     |       | 0.000609  |                                                |
| t — 2.282          |       | t — 2.145 |                                                |
|                    |       | .05       |                                                |

**Appendix Table 8. Single Analysis of Variance of Average Daily Rates of  
Growth for 71 Flocks of One Breed Produced by 22 Growers. \***

| Source of<br>Variation                     | Degrees of<br>Freedom | Sum of<br>Squares | Mean<br>Squares |
|--------------------------------------------|-----------------------|-------------------|-----------------|
| Total                                      | 70                    | .00029822         |                 |
| Between<br>interactions of<br>grower, etc. | 21                    | .00009768         | .00000465       |
| Error                                      | 49                    | .00020054         | .00000409       |
|                                            |                       |                   |                 |
| Between interactions<br>of grower, etc.    |                       | F — 1.1369;       | F — 1.78        |
|                                            |                       | .05               |                 |

\* Average daily rates of growth adjusted to eliminate trend, seasonal and age variations.







